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Seasonal Changes in Florida Grapefruit

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FACTORS INFLUENCING QUALITY OF COMMERCIAL GRAPEFRUIT

Grapefruit (*Citrus paradisi* Macfad.), now one of our highly important fruits, did not become commercially popular in the United States until about 1885. More than 5½ million bearing grapefruit trees, at least 5 years old, were growing in Florida, Texas, Arizona, and California in 1942.³ About 44 percent (193,367 acres) of the total acreage was in Florida. The four States mentioned produced over 263 million boxes of grapefruit from 1934 to 1941. Florida produced

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² Acknowledgment is due the following growers and producers for their generous cooperation in providing fruit used in the investigation: A. E. Barnes, Ralph Boswell, W. S. Buckingham, Chase Investment Co., L. P. Christensen, Di Giorgio Fruit Corporation, H. J. Edsall, B. F. Floyd, M. A. Glaspey, E. H. Hurlebaus, W. O. Kirkhuff, Mrs. W. J. Krome, Manatee Fruit Co., E. L. Mathews, Plymouth Citrus Growers Association, Lawrence Pope, A. V. Saurman, Mrs. Sarah M. Snively, J. T. Thurston, G. C. Valentine, and S. A. Whitesell. Acknowledgment is also due J. R. Winston, who was in general charge of the work, and other staff members of the Division of Fruit and Vegetable Crops and Diseases as follows for their assistance in conducting the investigation: B. R. Briggs, Denice Coburn, Robert Dyer, Marian Floyd, Mrs. Varina L. Freeman, Francis Ingley, Mary Jane Kirst, G. B. Knight, G. A. Meckstroth, Robert Reehl, G. Lee Roberts, M. Bryan Sunday, Edward Thomas, and Mrs. Frances Whitley; the assistance of other staff members of the United States Department of Agriculture who regularly participated as taste judges is also acknowledged.

³ WILLSON, H. F. MARKETING FLORIDA CITRUS: SUMMARY OF 1941-42 SEASON. Fla. Dept. Agr. State Market Bur., 82 pp. 1942. [Processed.] (See pp. 79-82.)

54 percent of them; according to market reports 35 percent of the Florida fruit is from seedless varieties. The average gross return for the Florida crop from 1932-33 to 1941-42 was \$15,477,244, the lowest being \$12,289,942 in 1939-40 and the highest \$22,849,773 in 1941-42.⁴

Correlating the internal quality of grapefruit with its physical characters and its chemical constituents as they change during the shipping season gives a better idea of the characteristics of the fruit that enters commerce; such correlation should enable growers to forecast with a reasonable degree of assurance the probable quality of the fruit on any particular date. Only if fruit is harvested when high palatability is assured, can shipping space be utilized most effectively and unfavorable consumer reactions be avoided. The benefits from proper harvest dates are particularly important when food conservation is essential and transportation facilities are congested.

The information presented in this bulletin on the physical characters and the chemical constituents of sprayed and unsprayed Florida grapefruit during the four seasons, or crop years, from 1939 to 1943, on the changes that occurred in the fruits as they matured and ripened, and on the factors that influenced eating quality and food value, should serve as a basis for improving maturity standards and for establishing legal picking dates for both seedy and seedless varieties. Heretofore varieties have not been differentiated in considering maturity standards or in choosing harvest periods.

The summary of the results of studies presented in this bulletin is based on the periodic analysis of more than 15,000 individual fruits and more than 1,000 composite samples of 25 to 50 fruits each. The principal varieties studied were the seedy Duncan⁵ and the seedless Marsh; the pink-fleshed, seedy Foster and the pink-fleshed, seedless Thompson also were used in some of the tests. These varieties were budded on rough lemon or sour orange rootstock and were grown on soils of various types. Both unsprayed fruits and those sprayed with lead arsenate according to commercial practice were analyzed.

Degreening of the rind was found to be associated with the ripening of the fruit on the tree. By January or February practically all the green had disappeared and the characteristic yellow had developed.

The average weight of the fruit increased with maturity, but the Duncan fruit was heavier than that of the Marsh. Increase in size, represented by changes in the diameter, also was associated with the development of the fruit, but the rate of size increase decreased as the fruit ripened.

The fruit had slightly thicker rind when the trees were on rough lemon rootstock, especially on light, sandy soils.

Immature grapefruit had ricey-textured flesh and that picked between November and January was usually coarse; that picked after January or February, however, had good texture. Changes in the color of the flesh were usually associated with changes in texture, the good-textured fruits having a deeper yellow or tannish-yellow flesh color.

⁴ SCRUGGS, F. H. ANNUAL FRUIT AND VEGETABLE REPORT: 1941-42 SEASON. Fla. Dept. Agr. State Market Bur., 83 pp. 1942. [Processed.] (See p. 9.)

⁵ In this bulletin the terms "Duncan" and "Duncan varieties" refer to a type of seedy grapefruit usually referred to in commerce as "Florida Common." It is possible that most of the groves producing this type of fruit may owe their origin directly or indirectly to the parent Duncan tree. Citriculturists generally are of the opinion, however, that they came from different sources of old, noteworthy seedling trees. The Duncan type fruits and trees have so many points in common that in most cases differentiation is impossible. The history of many of the groves is so obscure that the source of the budwood will never be known.

The volume of juice, computed as milliliters of juice per 100 gm. of fruit, increased with development until the fruit was ripe, when it remained rather constant. Varieties differed in juice content. Probably because of its practically seedless character, the Marsh consistently had a slightly greater amount of juice than the Duncan.

In immature fruit there was no significant difference in flavor (taste) among the several varieties regardless of the rootstock. Rootstock did, however, affect the quality of the ripened fruit; fruit on sour orange stock was superior in flavor to that on rough lemon. Furthermore, although the varieties Marsh and Duncan were about equal in quality when on sour orange, the Duncan was rated superior to the Marsh when they were on rough lemon.

There was a gradual lowering of concentration of ascorbic acid in the fruit as it matured and ripened, but the total ascorbic acid per fruit tended to increase as the volume of the juice increased with advancing maturity.

The total ash content of grapefruit juice was generally highest in immature fruit; it gradually decreased as maturity progressed, although very ripe fruit picked in April showed a slight increase. Analyses of the ash of the flesh showed a greater content of potassium in the Duncan than in the Marsh fruit. Analyses also showed a greater content of calcium and magnesium and in some cases of potassium in fruit picked in November, as it approached legal maturity, than in that picked in May, when it was very ripe; generally, however, the greatest amounts of manganese were found in very ripe fruit picked in May. The content of iron varied considerably but showed no definite trend. However, the variations among groves and picking periods are such that the small differences found between varieties and rootstocks are of doubtful nutritive or statistical significance.

Pectic constituents generally decreased with the ripening of the fruit, protopectin being more consistent than soluble pectin in this respect. The middle-lamella pectin was erratic, but it had a tendency to decrease as the fruit ripened.

During the commercial shipping season the acidity of the juice decreased gradually with ripening. In very ripe fruit picked in April and May the acidity decreased abruptly.

Reducing sugars increased with the ripening of the fruit. Sucrose usually increased during the fall months, remained rather constant during midseason, and decreased sharply between February and April. Total sugars increased during the fall and midseason and usually remained constant in ripe fruit.

Total solids, or total soluble solids, (principally sugars) were generally highest when the grapefruit was in prime eating condition. Slightly lower total solids were usually found earlier in the season in immature fruit and also late in the season in very ripe fruit. Marsh and Duncan fruit on sour orange rootstock contained a greater amount of total solids than did that on rough lemon. Comparisons between varieties on the same kind of rootstock showed that the Duncan contained higher total solids than the Marsh.

A downward trend in total acid characterized both Marsh and Duncan as they ripened, but the Duncan was consistently higher in total acid than the Marsh. Although total acid was influenced more by variety than by rootstock, the fruit on sour orange rootstock was rather consistently higher in total acid than that on rough lemon.

The solids-to-acid ratio generally increased with the ripening of the fruit. This increase was primarily due to a diminution in the total acid of the fruit, since the total solids remained rather constant in ripe fruit.

Spraying the trees and fruit in July with one application of lead arsenate (at the rate of 1 pound of lead arsenate to 100 gallons of water), the practice commonly followed commercially, brought about a significant reduction in total acid. The total acid of immature sprayed fruit was about 4 to 9 percent below that of the unsprayed, and that of very ripe sprayed fruit was as much as 21 to 26 percent less. The lowering of the acidity by spraying with lead arsenate resulted in higher ratios of total solids to total acid; this, in turn, resulted in earlier maturity, as judged by present legal standards, and more palatable fruit, as shown by the higher average numerical taste ratings. On the other hand, spraying resulted in a slight decrease in the weight of the fruit and consequently in its size. It did not, however, significantly lower the volume of juice computed on a percentage basis or as milliliters of juice per 100 gm. of fruit, or affect the concentration of ascorbic acid or the total solids.

DEFINITIONS OF MATURITY AND RIPENESS

Throughout this bulletin reference will be found to maturity standards, which are legal requirements established by State laws and enforced by State and Federal regulatory agencies. In this study the characteristics of the principal varieties of grapefruit have been related to the legal maturity standards at different times prior to and throughout the normal harvesting period.

To avoid possible confusion in, or misconception of, the meaning of the terms "maturity" and "ripening" as they are used in this publication their common horticultural meanings are defined. Maturity refers to a stage of development of a fruit; ripening, to the process by which a mature fruit when held under suitable conditions becomes edible. A mature fruit is one that has attained such a stage of development that it will ripen with acceptable eating quality. Fruits with starchy reserves, such as apples and pears, may be mature at harvesttime, but they may not ripen or become edible until sometime thereafter, when they attain their soft, juicy, aromatic qualities. Grapefruit and oranges are different from apples and pears in this respect; they contain practically no starch and do not undergo such a marked change in composition after being severed from the tree. Since the ripening processes of citrus fruits can occur only while they are attached to the tree, it is obvious that they should not be harvested until they are mature and hence ripe. Instead of increasing in quality after harvest, grapefruit and oranges tend to lose quality, the rate of this loss being correlated with the temperature at which the fruit is held.

It is important to keep in mind, therefore, that grapefruit must be of desirable eating quality at the time of harvest in order to be regarded as mature. On this basis, then, grapefruit must always be tree-ripened. The importance of maturity of grapefruit and of the legal definition of maturity as established in different producing sections, therefore, becomes apparent. The present study was designed to show the seasonal behavior of the principal varieties of grapefruit; for the purpose of comparison the relation is shown

between this behavior and the legal maturity standards in effect when this investigation was conducted.

RELATION OF FINDINGS TO MATURITY LAWS

Ramsey (26)⁶ stated that appearance alone, involving texture, color, and scars, is important, but in the final analysis satisfactory eating quality and juice content are of greater importance in giving consumer satisfaction. Fabian and Blum (9) reiterated the same point of view in saying that flavor is one of the most important attributes of any food produced for human consumption. No matter how attractive the food may be in appearance, how expensively it may be packaged, or how nutritious it is, future sales will be negligible if it does not suit the taste of the consumer. Provan (25) stated that immature grapefruit which possesses a sharp and raw bitterness will never be popular with the Melbourne, Australia, public. Acidity, the Brix test, or the solids-to-acid ratio did not fully indicate a suitable period of maturity, but the palate test showed that grapefruit had developed full flavor and could be considered mature after July 1 in Australia.

The results presented in this bulletin indicate a very close correlation between the flavor of grapefruit, as determined by taste, and the seasonal changes in the weight and texture of the fruit, the color of its flesh, the milliliters of juice per 100 gm. of fruit, and the ratio of total solids to total acid. These increased with the maturity and the ripening of the grapefruit on the tree, the trends of change during the season being rather similar in the different lots. By recording the picking dates and plotting the total solids and total acid in nomograph form, it was possible to show the relation of these factors to each other in fruit at its earliest stage of acceptability, as judged by its flavor, and eventually to determine a minimum standard of acceptability for the different varieties.

The flavor of the grapefruit used in this study began to meet consumer approval as follows: Marsh on rough lemon rootstock from about December 1 to January 22 (fig. 1, *A*); Marsh on sour orange, from about October 20 to January 1 (fig. 1, *B*); Duncan on rough lemon, from about November 15 to January 3 (fig. 1, *C*); and Duncan on sour orange, from about November 1 to January 1 (fig. 1, *D*). There was a marked seasonal variation, also, in the maturity dates; grapefruit matured earliest during 1939-40 and latest during 1942-43.

The interrelation of the means of physical characters and chemical constituents of Marsh and Duncan grapefruit for the four seasons are presented in figure 2. They show that according to flavor ratings Duncan grapefruit began to meet consumer approval about December 1 to 20 and Marsh about December 1 to January 1. These findings are in agreement with the popular local opinion in Florida, where grapefruit is generally regarded as too tart for eating before Christmas.

The fruit of both the Marsh and the Duncan variety became more acceptable in quality earlier in the season when the trees were sprayed with lead arsenate than when they were not sprayed with it. This earlier maturity appears to be due primarily to a lowering of the total acid content of the fruit as a result of some obscure physiological process induced by the application of the arsenical. The comparative

⁶ Italic numbers in parentheses refer to Literature Cited, p. 47.

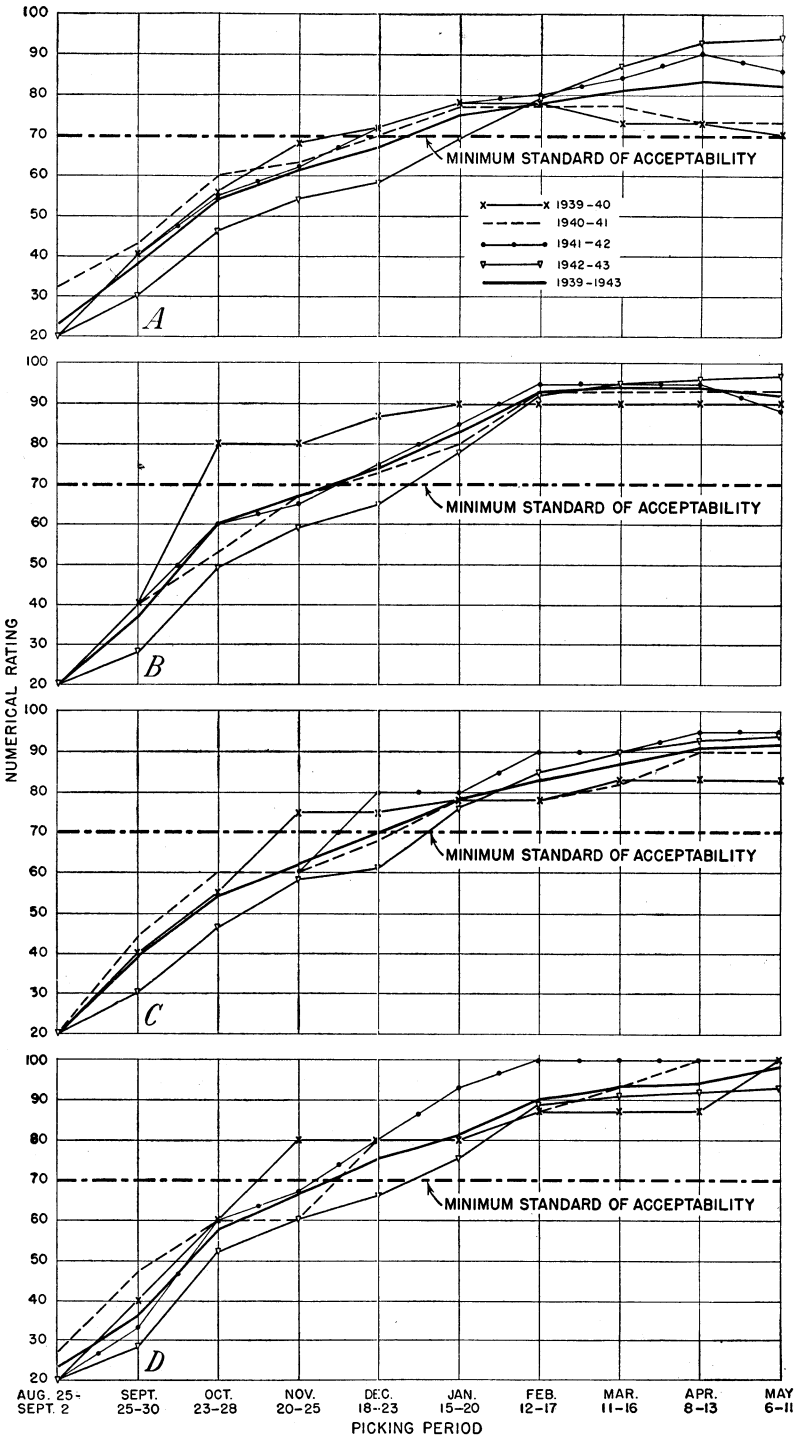


FIGURE 1.—Seasonal changes in average numerical ratings of grapefruit flavor, 1939-43: A, Marsh on rough lemon rootstock; B, Marsh on sour orange; C, Duncan on rough lemon; D, Duncan on sour orange.

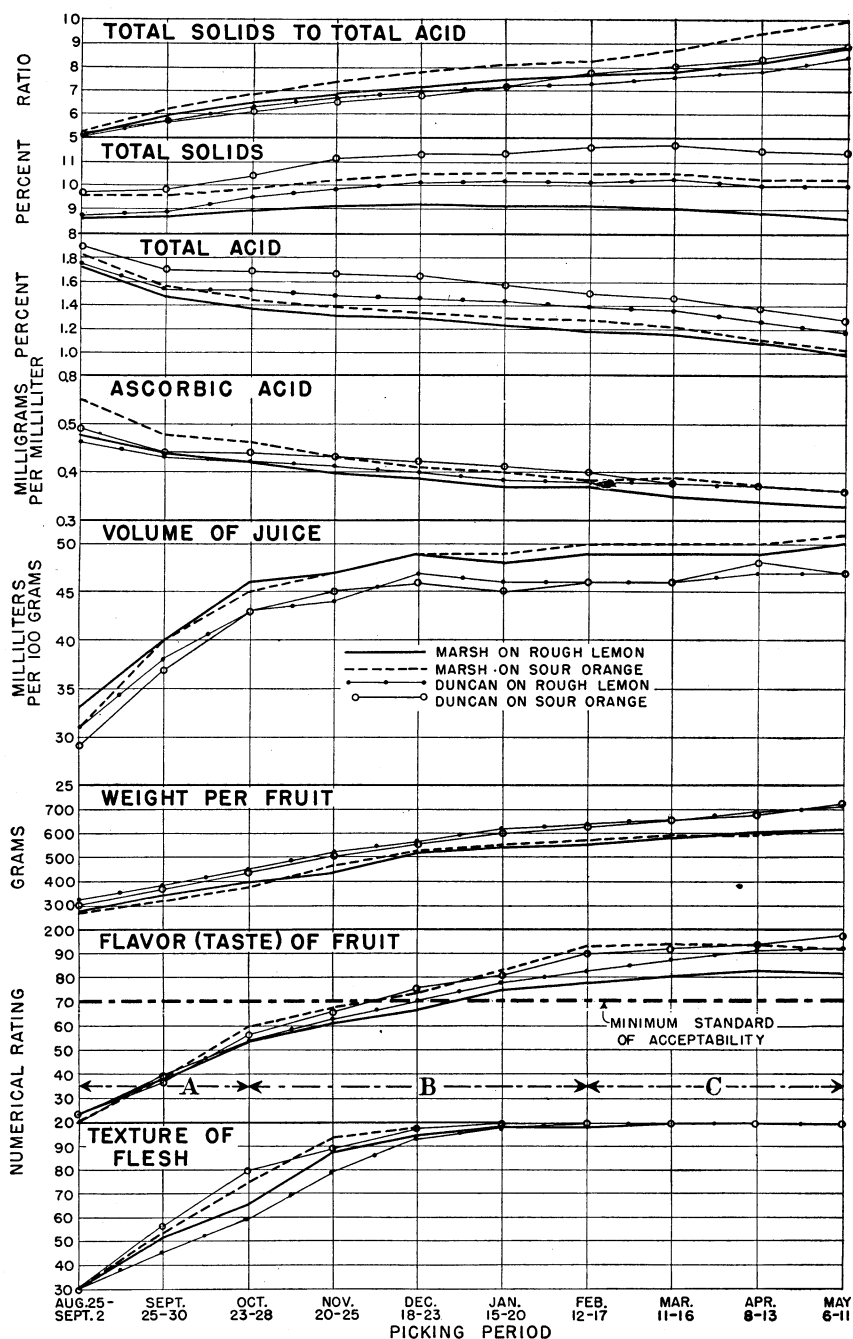


FIGURE 2.—Interrelation of physical characters and chemical constituents of Marsh and Duncan grapefruit on rough lemon and sour orange rootstocks. (Averages for four seasons, 1939-43, except for volume of juice, which was for three seasons, 1940-43. For explanation of A, B, and C of flavor graph. see p. 24.)

composition of sprayed and unsprayed fruit is shown in tables 34 to 60, Appendix.

In Marsh grapefruit rated as pleasantly tart in flavor (fig. 3) the total solids ranged from 7.37 to 12.53 percent and the total acid from 0.97 to 1.67 percent. In pleasantly tart Duncan grapefruit (fig. 4) the total solids ranged from 8.37 to 14.39 and the total acid from 1.07 to 2.38 percent, respectively. In other instances there was a greater range in total solids and total acid in acceptable Duncan fruit than in acceptable Marsh fruit, particularly in total acid.

The differences between acceptable Marsh and Duncan fruit are brought out plainly by superimposing the nomograph for Marsh (fig. 3) on that for Duncan (fig. 4). It can be readily seen that the two nomographs do not fit particularly well, because the acceptable Marsh fruit generally had a lower content of total solids and a lower and smaller range of total acid than the Duncan fruit. These charac-

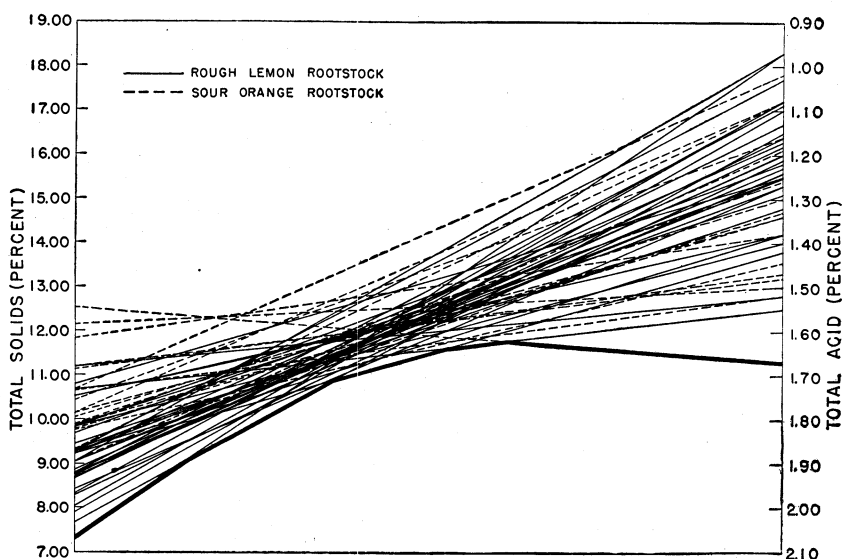


FIGURE 3.—Nomograph showing the contents of total solids and total acid in Marsh grapefruit when first rated as meeting consumer approval according to the taste test. These data were obtained during four seasons (1939–43) and included tests on fruit on rough lemon and sour orange rootstocks as well as on that from trees sprayed with lead arsenate. Heavy line indicates minimum total solids and maximum total acid of acceptable grapefruit.

teristics of Marsh and Duncan fruit (seedless and seedy varieties, respectively) strongly suggest that no single internal grade standard should be applied to all varieties of grapefruit as is done at the present time. In order to guarantee acceptable grapefruit to the consumer, it appears necessary to devise dual maturity and juice grade standards, one for varieties like the Marsh, which are characteristically lower in total solids and total acid than the varieties like the Duncan, and the other for Duncan and similar varieties. It happens that this differentiation can be made on the basis of the seedless or the seedy character of the fruit, which is readily ascertainable even when the name of the variety is not known.

It should be kept in mind that the physical and chemical changes occurring during the ripening of grapefruit are very gradual. In dealing with such data the use of nomographs, such as those presented, offers a practical way of correlating different factors and obtaining a better working basis for maturity laws and internal fruit grades. It is not likely, however, that these alone would prove wholly satisfactory unless supplemented by picking dates that are logically selected and legally established.

A maturity standard based on these findings would undoubtedly defer the shipment of some early grapefruit legally mature under the present law. On the other hand, it would make possible the earlier canning and shipment of acceptable grapefruit of certain varieties that are characteristically high in total solids and total acid. Actually such fruit is highly palatable, but under the present laws it is rated

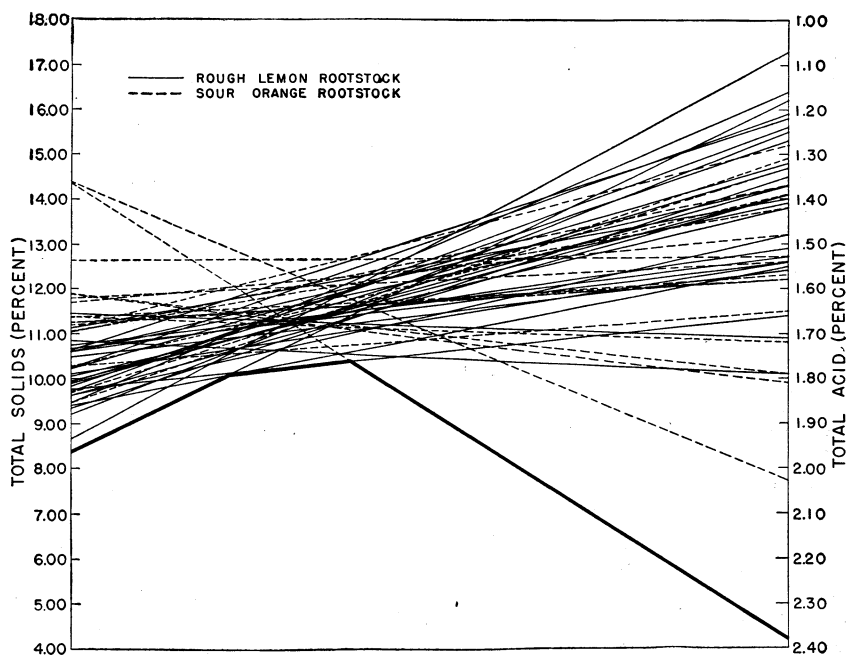


FIGURE 4.—Nomograph showing the contents of total solids and total acid in Duncan grapefruit when first rated as meeting consumer approval according to the taste test. These data were obtained during four seasons (1939-43) and included tests on fruit on rough lemon and sour orange rootstocks as well as on that from trees sprayed with lead arsenate. Heavy line indicates minimum total solids and maximum total acid of acceptable grapefruit.

technically as immature because of low ratios. During the past few seasons much of this high-quality fruit has been encountered and, in accordance with legal requirements, has been discriminated against.

In considering grapefruit maturity, varietal characteristics apparently have not been emphasized in the past because all varieties of grapefruit are subject to the same maturity laws. In Florida, these laws are based largely on three components (color of rind, chemical composition, and volume of juice) and are briefly cited as follows from the Citrus Fruit Laws, August 1941 (10, p. 38):

Section 3. That within the purpose and meaning of this Act, grapefruit shall be deemed to be mature only when clipped or picked, or otherwise severed from the tree each grapefruit shows a break in color caused solely by nature, and when the total soluble solids of the juice thereof is not less than seven (7%) percent, and when the ratio of total soluble solids of the juice thereof to the anhydrous citric acid is as set forth in subsection (a) of this Section, and when the juice content of said grapefruit is not less than the minimum requirement for the respective sizes of said grapefruit as set forth hereinafter in subsection (b) of this Section.

When the total soluble solids referred to in subsection (a) of this section range from 7 to 9 percent, the minimum total soluble solids-acid ratio is 7 to 1; when the range of total soluble solids is from 9.1 to 9.9 percent the ratio is graduated, the minimum ratio being 6.50 to 1.

In Texas, the ratio requirements for grapefruit are very similar to those in Florida and range from 6.5 to 1 to 7.2 to 1; however, the total soluble solids take in a range of from 9 percent to 11.5 percent. Section 3 (28, *p. 132*) of the Texas maturity law is quoted as follows:

Section 3. That within the purpose and meaning of this Act, pomelos (grapefruit) shall be deemed to be mature only when the ratio of total soluble solids of the juice thereof to anhydrous citric acid is as follows:

(a) When the total soluble solids of the juice is not less than nine percent (9%), the minimum ratio of total soluble solids to the anhydrous citric acid shall be seven and two-tenths to one (7.2-1).

(b) When the total soluble solids of the juice is not less than ten percent (10%), the minimum ratio of the total soluble solids to the anhydrous citric acid shall be seven to one (7-1).

(c) When the total soluble solids of the juice is not less than eleven percent (11%), the minimum ratio of total soluble solids to the anhydrous citric acid shall be six and eight-tenths to one (6.8-1).

(d) When the total soluble solids of the juice is not less than eleven and one-half percent (11.5%), the minimum ratio of the total soluble solids to the anhydrous citric acid shall be six and one-half to one (6.5-1).

In Arizona (1, *pp. 22-23*), the minimum ratio of total soluble solids to acidity is 6 to 1. In California (4), dual ratio requirements prevail, depending on the section where the fruit is grown and the minima are 5.5 to 1 and 6 to 1. The reason for this dual standard is the difference in climatic conditions prevailing south and east of San Geronio Pass, which results in the grapefruit grown in this area having at maturity a higher percentage of soluble solids to acid than that grown in the area north and west of San Geronio Pass.

In Texas, Wood and Reed (33) found that grapefruit from widely separated orchards on different soil types and under different soil management matured at approximately the same time. The various cultural practices exerted more influence on the physical characteristics than on the chemical composition of the fruit. They stated that the total soluble solids content and the solids to acid ratio, in conjunction with a specified minimum juice content, appeared to be the most practical and the best measures for determining the maturity of grapefruit. In Arizona, Hilgeman and Smith (16) and Hilgeman, Van Horn, and Martin (17) found that the exact point at which a grapefruit may be considered edible presented many difficulties and that no consistent differences in maturity as indicated by the ratio of the total solids to acid were noted in fruit from various fertilizer plots, but that marked seasonal differences were observed. Hilgeman (15) advised that no fixed standard be adopted and suggested that an authority be established and empowered to set standards for each season as might be deemed advisable, to prevent the shipment of unpalatable fruit.

Baier (3) conducted maturity studies on Marsh grapefruit grown in

California and Arizona. He pointed out that it became evident during the course of the investigation that Marsh grapefruit from different sections varied considerably in characteristics when it passed the fundamental tests of maturity. Thus came the suggestion for the so-called dual standard, for some years a part of the California Fruit, Nut, and Vegetable Standardization Act.

MATERIAL, METHODS, AND RELATED INFORMATION

EXPERIMENTAL PROCEDURES

The present investigation covered 4 seasons, 1939-40, 1940-41, 1941-42, and 1942-43. Analyses were made mostly on the Marsh and Duncan varieties of grapefruit, since these are the principal ones grown in Florida. In addition, however, analyses were made on the Foster variety during 1939-40 and 1940-41 and on the Thompson during 1941-42 and 1942-43. Analyses were made periodically on the fruit from 10 different groves of Marsh grapefruit on rough lemon rootstock, from 6 of Marsh on sour orange, from 8 of Duncan on rough lemon, and from 6 of Duncan on sour orange.

In addition extensive tests were made to determine the effects of lead arsenate spray on the composition and quality of Marsh and Duncan grapefruit. Tests were made on the fruit from 27 different plots of trees sprayed with lead arsenate and on that from 28 comparable unsprayed plots. Spray was applied in July, many weeks prior to commercial harvest, generally at the rate of 1 pound of lead arsenate to 100 gallons of water. The tests on the fruit were started about the last of August and continued until the middle of May of each season; therefore, the analyses included fruit in various stages of maturity and ripening.

In making the selection for the experimental plots in commercial groves a definite plan was followed: Plots were chosen in the ridge district, where the soils are usually low in organic matter (pl. 1); in the east and west coast districts, where the soils have a higher organic matter content (pl. 2); and in the Homestead district, where the soils are very rocky (pl. 3). Pertinent information on the soils and locations of the experimental plots is given in table 1, and the soils are described briefly on pages 17 and 18.

In each of these districts the plots were made up of Marsh and Duncan varieties on rough lemon and sour orange rootstocks. Other plots were added to supplement the findings. These were selected on the basis of the predominating variety or rootstock found in the particular district. For example, if the Marsh on rough lemon rootstock was most common, more of such plots were chosen in an attempt to make the investigation representative of existing conditions. In these groves plots of 15 to 25 trees each were selected. In the choice of both groves and plots care was taken to avoid abnormal cultural and fertilizer practices, and complete records relating to them were obtained each season. Since this study was undertaken for the purpose of obtaining an over-all picture of grapefruit and the quality that might be expected on the market at different times, it is not deemed necessary to set forth in detail the production practices followed in each grove. The groves were in good average condition and had been supplied with ample amounts of primary and secondary nutritive elements. Very young and very old trees and those producing very

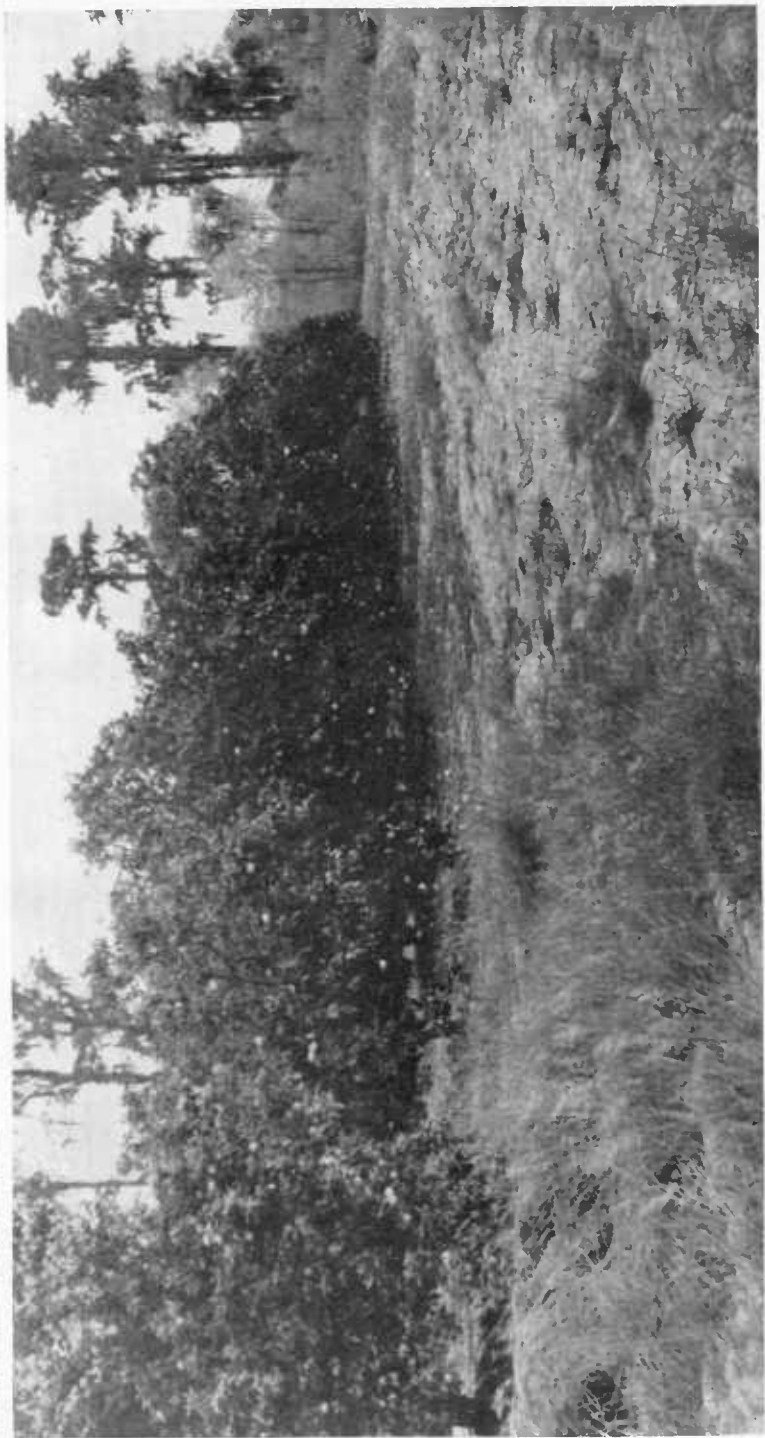
TABLE 1.—*Varieties of grapefruit, rootstocks on which they were grown, soils, and locations of experimental plots in Florida, 1939-43*

Variety	Rootstock	Age of trees ¹	Location	Soil	Season of investigation
Marsh	Rough lemon	<i>Years</i>			
		18	Davenport	Norfolk sand	1939-40, 1940-41, 1941-42, ² 1942-43, ²
		26	Lake Hamilton	do	1940-41, 1941-42, 1942-43, ²
		15	Windermere	Norfolk fine sand	1939-40, ² 1940-41, ²
		15	Minneola	do	1942-43, ²
		15	Howey In The Hills	Blanton fine sand	1942-43, ²
		22	Bradenton	Bradenton fine sandy loam, ³	1939-40, 1940-41, 1941-42, 1942-43, ²
		20	Clearwater	Norfolk fine sand	1942-43, ²
		15	Fort Pierce	Bradenton fine sandy loam, ³	1939-40, 1940-41, 1941-42, 1942-43, ²
		About 27	Homestead	Rockdale rockland, clayey phase.	1939-40, 1940-41, 1941-42.
Do	Sour orange	24	do	Rockdale rockland, sandy phase.	1941-42.
		20	Davenport	Norfolk sand	1939-40, 1940-41, 1941-42.
		About 22	Bradenton	Bradenton fine sandy loam, ³	1939-40, 1940-41, 1941-42, 1942-43, ²
		16	Vero Beach	Manatee fine sandy loam, ³	1939-40, 1940-41, 1941-42, 1942-43, ²
		19	do	Felda loamy fine sand ³	1942-43, ²
		25	Fort Pierce	Bladen fine sandy loam	1942-43, ²
		24	Homestead	Rockdale rockland, sandy phase.	1941-42.
		18	Davenport	Norfolk sand	1939-40, 1940-41, 1941-42, ² 1942-43, ²
		26	Lake Hamilton	do	1940-41, 1941-42, 1942-43, ²
		20	Minneola	Norfolk fine sand	1942-43, ²
Duncan	Rough lemon	24	Palmetto	Bradenton loamy fine sand, ³	1939-40, 1940-41, 1941-42, 1942-43, ²
		20	Clearwater	Norfolk fine sand	1942-43, ²
		28	do	Blanton fine sand	1942-43, ²
		15	Fort Pierce	Bradenton fine sandy loam, ³	1939-40, 1940-41, 1941-42, 1942-43, ²
		About 27	Homestead	Rockdale rockland, clayey phase.	1939-40, 1940-41, 1941-42.
		20	Davenport	Norfolk sand	1939-40, 1940-41, 1941-42.
		About 30	Dundee	do	1942-43, ²
		31	Palmetto	Bradenton fine sandy loam, ³	1939-40, 1940-41, 1941-42, 1942-43, ²
		22	Vero Beach	Manatee fine sandy loam, ³	1942-43, ²
		15	do	Parkwood fine sandy loam.	1939-40, 1940-41, 1941-42, 1942-43.
Foster (pink)	do	19	do	Felda loamy fine sand ³	1942-43, ²
		25	Fort Pierce	Bladen fine sandy loam	1942-43, ²
Thompson (pink)	do	10	Bradenton	Bradenton fine sandy loam, ³	1939-40, 1940-41.
		8	do	Bradenton loamy fine sand, ³	1941-42, 1942-43.

¹ Age of trees at the time the experiment was started.² Plots sprayed with lead arsenate compared with control plots.³ Tentative name of soil mapped in Florida but not yet correlated.

light crops of fruit were not used. Care was always exercised to pick only fruits from the regular bloom; otherwise, the grapefruits for all the tests were selected at random.

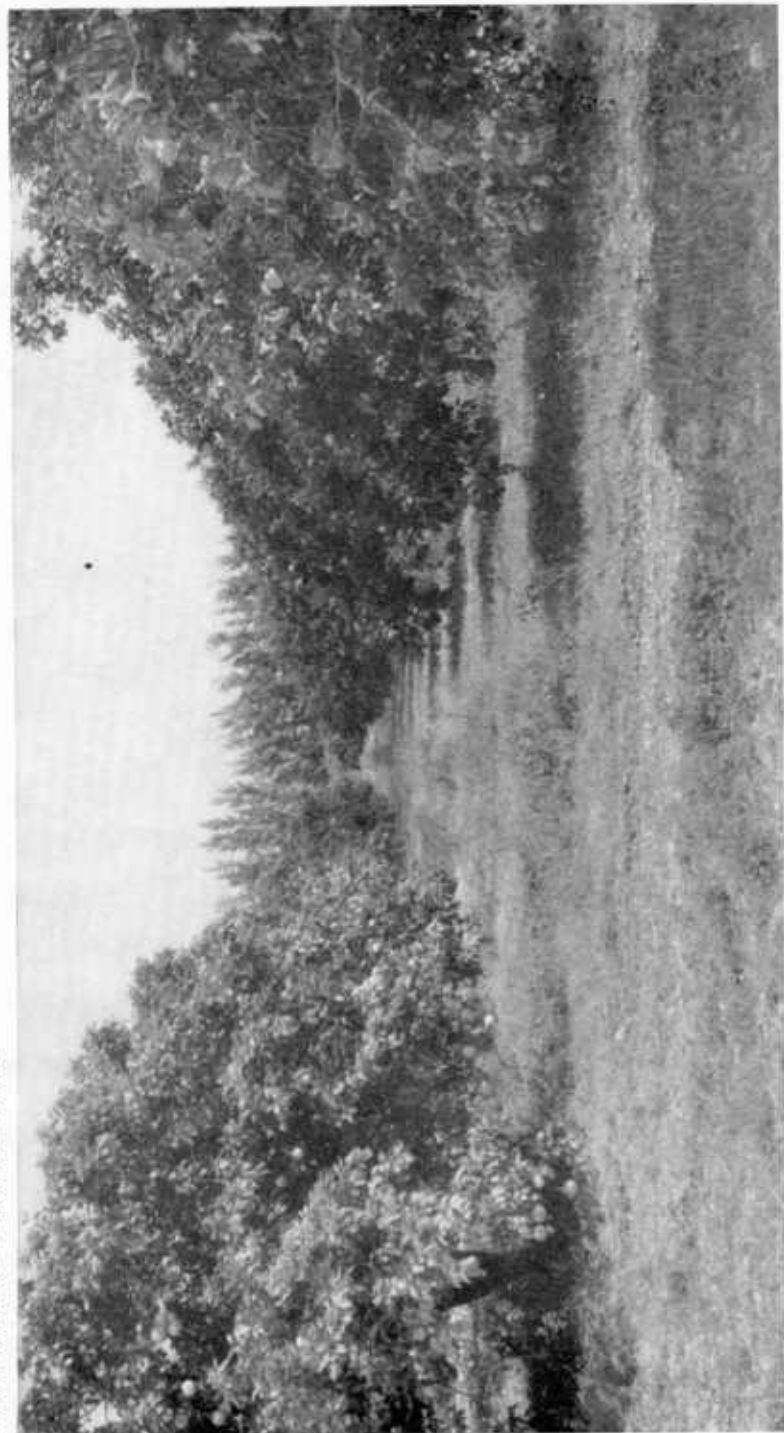
The fruit samples were taken to the laboratory at Orlando, Fla., immediately after they were picked and were placed in storage at 32° F. until tested. Each sample consisted of 60 or more grapefruits picked at random from the 15 to 25 trees. During the 3 seasons from 1939-1942, 25 fruits were analyzed individually. These individual analyses brought out the variation among the fruits and the percentages in each sample which passed or failed to pass existing legal requirements for total solids and acid. The remaining fruits were used



Sandy soil of low organic-matter content suited to grapefruit or orange on rough lemon rootstock. Typical "high pine" location



Soil of medium to high organic-matter content suited to grapefruit or orange on sour orange rootstock.
Typical hammock location.



Rockdale rockland soil in the Homestead district fairly well suited to citrus. It differs from most citrus soils in Florida. Before it is planted to citrus groves, the virgin soil requires thorough scarification in order to break up the surface rock crust; in addition, holes are usually blasted for each tree.

for taste tests (fig. 5) and for ascorbic acid determinations. For the latter determinations the juice was extracted from the grapefruit by hand squeezing and then strained through cheesecloth in order to remove the seeds and pulp. Aliquots of this composited juice were used in the determination of ascorbic acid. During 1942-43 all the tests were made on composited juice samples after the seeds and pulp had been separated from the juice.

Samples were collected from all the groves at 4-week intervals. Tests were started about the last of August on immature fruit and continued through each season until about the middle of May, when the fruit was very ripe or overripe, as shown by the presence of sprouting seeds, granulation, and off-flavors. This long period of sampling provided information on the changes in physical characters and chemical constituents of the fruit during the various stages of maturity and ripening. (See tables 13 to 60, Appendix.)

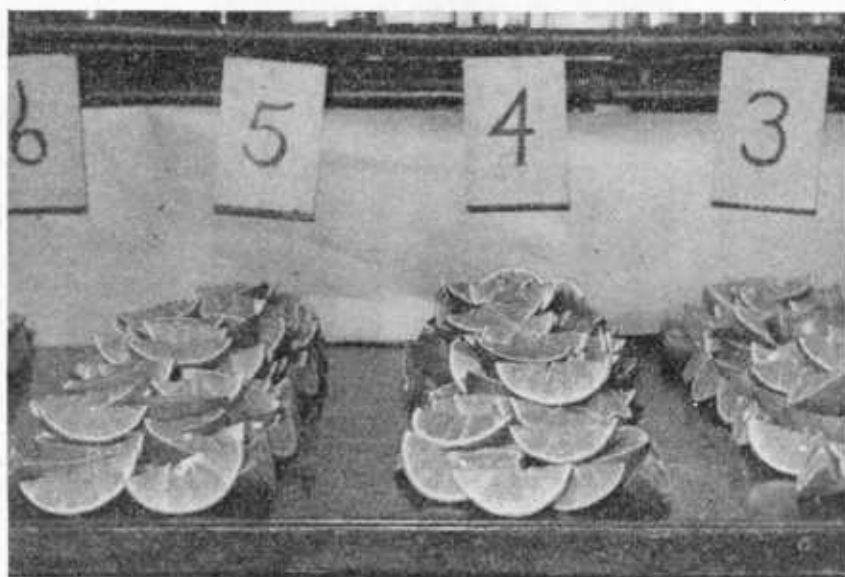


FIGURE 5.—Samples of grapefruit arranged on a laboratory table for flavor, or taste, evaluation. Each judge was advised to taste several pieces before rating a sample according to the arbitrary scale shown on score card form, page 16.

The analyses included determinations of weight and diameter of the fruit; color of rind and flesh; thickness of the rind; texture of the flesh; volume of juice; flavor (taste); ascorbic acid content; pH value; total solids; total acid (as anhydrous citric acid); sucrose and reducing sugars; soluble pectin; protopectin; middle-lamella pectin; total ash; and the content of potassium, calcium, magnesium, phosphorus, manganese, and iron in the ash of grapefruit flesh. The data for total solids and total acid for the principal varieties were analyzed statistically (27). (See tables 13 to 33, Appendix.)

During 1939-40 the juice was extracted from the fruit by means of a hand press (fig. 6); during the other seasons an electric reamer (fig. 7) was used. Much more juice was extracted from the fruit by the electric reamer than by the hand-operated press.

Official methods were followed in determining the chemical constituents (2).

FACTORS INFLUENCING QUALITY AND THE METHOD OF EVALUATING PALATABILITY

The internal quality of grapefruit is influenced by several factors such as acidity, sugar content, ratio of total solids to total acid, juici-

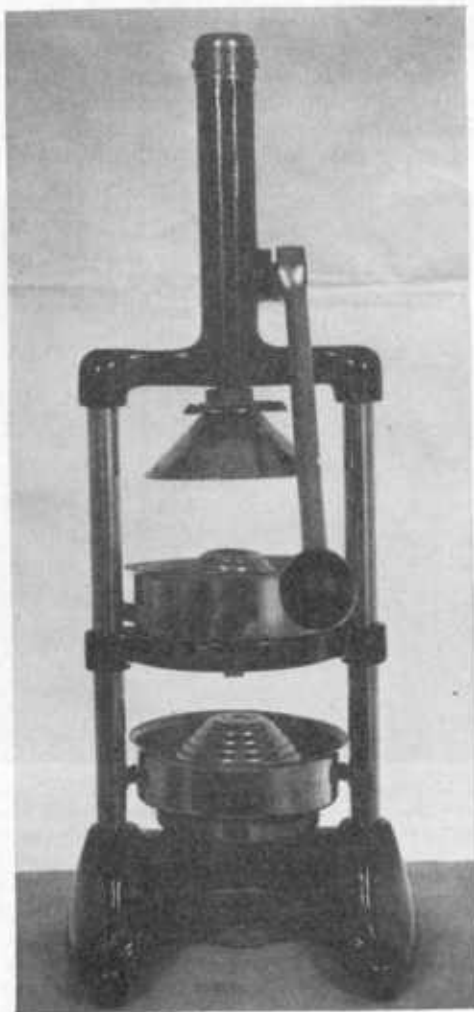


FIGURE 6.—Hand press used for extracting juices during 1939-40.

ness, texture of flesh, and aromatic constituents. The age of the fruit is also important. Immature grapefruit is usually very acid or tart and has a raw and immature taste, whereas overripe fruit held on the tree too long and that sprayed with high concentrations of lead arsenate may become insipid or develop disagreeable off-flavors. No one relishes immature, very acid, ricey fruit. There also appears to be a

prejudice against very insipid fruit or that in which the seeds have sprouted. Individuals differ in their preference for degrees of tartness and sweetness; some customarily add sugar and others use salt on grapefruit, but many prefer no added flavoring.

Throughout this investigation assays for flavor or taste were made on the fruit to which no sugar or salt had been added. In each test 30 to 50 grapefruits were used. The fruits were cut in half transversely, and from each half was cut a wedge-shaped piece for tasting (fig. 5).

Staff members of the Bureau of Plant Industry, Soils, and Agricultural Engineering and of the Bureau of Entomology and Plant Quarantine stationed at Orlando regularly officiated as taste judges. Frequently visitors also were present, and they too were invited to score the various samples. From 15 to 28 taste judges appraised and scored



FIGURE 7.—Electric reamer used for extracting juices during 1940-41, 1941-42, and 1942-43.

each lot of fruit, and the numerical ratings were averaged. Scoring of all samples of grapefruit was done according to the arbitrary standard scale shown on page 16.

At the beginning of each season the arbitrary standard scale to be used and the method of evaluating the internal quality of grapefruit were discussed with the staff members who were to participate as taste judges. At that time it was brought out that the numerical value of 70 would be the minimum standard of acceptability and that any grapefruit rated below that value would be considered undesirable. On the other hand, desirable internal quality was given values of 70 to 100 as indicated.

An effort has been made to correlate the internal quality of grapefruit, as determined by taste, with the total solids and the total acid

SCORE CARD FOR TESTING TASTE OR FLAVOR OF GRAPEFRUIT

Arbitrary standard	Taste or flavor of fruit	Numerical rating range corresponding to description	Individual numerical rating
Very acid.....	Very acid, raw, immature flavor.....	20-39	-----
Acid.....	Acid with absence of raw, immature flavor.....	40-59	-----
Tart.....	Too tart for consumer approval.....	60-69	-----
Pleasantly tart.....	Minimum stage of acceptability for consumer.....	70-79	-----
Pleasantly tart to sweet.....	Pleasant blend of sugars and acid, with very good texture and flavor.....	80-100	-----
Insipid (aged).....	Very sweet, watery, lacking in flavor, low in acidity, aged.....	50-100	-----

content of the fruit. This was accomplished by tabulating the percentages of total solids and total acid of all samples of grapefruit at the time they were first classified as meeting consumer approval and evaluated as pleasantly tart with an average numerical rating of 70 or higher. The results obtained were plotted in nomograph form and are presented in figures 3 and 4. These data designate within the nomograph the contents of total solids and total acid of acceptable fruit.

In applying grapefruit-maturity data to these charts, a straight line may be drawn from the percentage of total solids to the percentage of total acid. If this line lies within the area of the nomograph at all points (above the heavy line), the grapefruit would be considered acceptable. However, if it leaves the area of the nomograph at any point (crosses the heavy line), the fruit could not be considered of palatable eating quality. It is also interesting to note that usually when an acceptable grapefruit had a low total solids content it also had a low acidity, and a fruit with high or very high total solids content also had high acidity. An example of the latter is shown in figure 4, which indicates that Duncan fruit was acceptable when the acidity was 2.38 percent. Ordinarily this fruit would be considered far too acid, but the accompanying total solids content of over 14 percent demonstrated that taste was influenced by the ratio of solids to acid in this fruit.

METHODS FOR AVERAGING CERTAIN PHYSICAL CHARACTERS AND CHEMICAL CONSTITUENTS

COLOR OF RIND.—The color of the rind of each individual fruit was determined by matching it with the colors *A* to *I* shown in plate 4. The average color for each sample was ascertained by assigning a numerical value to each color and averaging these values (fig. 8); or each numerical average was converted to the nearest color designation, as shown in tables 13 to 60, Appendix.

COLOR OF FLESH.—The color of the flesh of each individual fruit was determined by classifying the fruit according to its nearest color designation: GY, greenish yellow; PY, pale yellow; and TY, tannish yellow. The average flesh color for each sample was ascertained by assigning a numerical value to each color designation and averaging these values (fig. 10); or each average was converted to the nearest color designation, as shown in tables 13 to 60, Appendix.

TEXTURE OF FLESH.—The texture of the flesh of each fruit was determined by classifying the fruit according to its nearest texture

designation: Ricey, coarse, and good. The average texture of the flesh for each sample was ascertained by assigning a numerical value to each texture designation and averaging these values (fig. 2); or each average was converted to the nearest texture designation, as shown in tables 13 to 60, Appendix.

AVERAGE pH VALUES.—The average pH value was determined by averaging the antilogs of the pH values and converting the average antilog back to the pH value (fig. 12).

INTERRELATION OF SOIL, ROOTSTOCK, AND QUALITY ⁷

A brief description of some of the soils planted to citrus is given herein because of the interrelation of soil, rootstock, and fruit quality. It is recognized that some soils are more suitable for citrus than others. Likewise, certain rootstocks are better adapted to the light, sandy soils, while others are better adapted to the heavier soils. For example, rough lemon is a very thrifty grower, has an extensive root system, and is used most frequently in soils in which the organic matter is low and the topography is rolling. Sour orange rootstock is used mostly in soils in which the organic matter is medium to high and where the topography is more or less level. There are, of course, exceptions where groves seem to thrive and produce satisfactory crops of high-quality fruit under good care and management, even when the rootstocks are not the ones usually planted on the particular soils.

Fruit quality appears to be influenced more by the rootstocks on which the trees are grown than by different soils, provided the conditions under which they are grown are similar. In view of this, it seemed desirable to ascertain how the composition and characteristics of the fruit might be influenced by the rootstocks in relation to their adaptation to the soils in which the trees were growing. A better knowledge of soils and rootstocks is necessary for efficient soil management and proves useful to those who contemplate the planting of new groves and who necessarily must consider the quality as well as the quantity of fruit that can be obtained.

The experimental plots in this investigation covered a wide range of types representative of the most important soils planted to citrus in the State. The soil types in the various plots are listed in table 1, and a brief description of each type as it occurs in the field plots follows:

NORFOLK SAND.—Norfolk sand and Norfolk fine sand are two of the most extensive soils planted to citrus in Florida. Norfolk sand is characterized by 4 to 6 inches of a gray sand underlain by 5 feet, and usually more, of yellow sand, which passes into sandy clay beds at varying depths below the surface. The soil is exceptionally well drained and subject to excessive leaching because of its low content of clay and organic matter.

NORFOLK FINE SAND.—Norfolk fine sand is similar to Norfolk sand except that more than half of it consists of fine plus very fine sand, with the result that this soil is usually considered a little more productive than the coarser textured Norfolk sand.

BLANTON FINE SAND.—Soil known as Blanton fine sand is closely related to Norfolk fine sand, differing from it mainly in the subsoil, which is slightly mottled pale-yellow to yellowish-gray fine sand and underlain at 5 feet or lower with sandy clay beds. This soil is not as excessively drained as the Norfolk fine sand.

⁷ Information on soil types furnished by Matthew Drosdoff, associate soil technologist, Division of Fruit and Vegetable Crops and Diseases.

BRADENTON FINE SANDY LOAM.⁸—Bradenton fine sandy loam was formerly included in the Parkwood series. It differs from the Parkwood in that a 6- to 10-inch sandy clay layer is found between the sandy surface soil and the marl substratum. Also the surface soil is much lower in organic matter than the Parkwood.

ROCKDALE ROCKLAND, CLAYEY PHASE.—The clayey phase of Rockdale rockland differs from the sandy phase in that the cavities are filled with a brown to reddish-brown sandy clay. It is considered slightly better for growing citrus.

ROCKDALE ROCKLAND, SANDY PHASE.—The sandy phase of Rockdale rockland consists of an oolitic limestone which is porous and honeycombed with numerous small cavities and holes from 2 to 24 inches or more deep filled with yellowish-gray fine sand.

MANATEE FINE SANDY LOAM.⁸—Manatee fine sandy loam was also formerly included in the Parkwood series. The surface 10 to 12 inches is black fine sandy loam underlain by 12 to 15 inches of a mottled gray fine sandy clay, which rests on a hard marl. Under natural conditions this is a very poorly drained soil.

FELDA LOAMY FINE SAND.⁸—Felda loamy fine sand is poorly drained under natural conditions and is characterized by a dark-gray loamy fine sand surface layer 8 to 12 inches in depth. This grades into a light-gray loamy fine sand spotted with yellow and brown. At approximately 30 inches is encountered a gray calcareous sandy clay mottled with yellow and brown and underlain with marl or limestone.

BLADEN FINE SANDY LOAM.—The surface of such soil to a depth of 5 to 7 inches is a gray or brownish-gray loamy fine sand grading into 8 to 10 inches of a very light gray loamy fine sand underlain by a gray heavy sticky fine sandy clay mottled with brown extending to a depth of 4 feet or more. This soil is a very poorly drained acid soil under natural conditions.

PARKWOOD FINE SANDY LOAM.—Parkwood fine sandy loam has about 10 to 15 inches of a dark-gray loamy sand surface soil grading into a 6- to 8-inch layer of a whitish marl with inclusions of gray fine sand. This is underlain by a somewhat hardened white marl. This soil is poorly drained under natural conditions.

BRADENTON LOAMY FINE SAND.⁸—Bradenton loamy fine sand is similar to Bradenton fine sandy loam but differs from it in that the sandy clay loam layer lies at depths usually between 30 and 42 inches and contains considerable organic matter. The color of this clay layer is sometimes similar to that of the hardpan in the Leon soil.

CLIMATOLOGICAL INFORMATION IN RELATION TO SEASONAL VARIATION

The results obtained during the course of this study varied considerably from season to season. For example, the average total solids content was lower during 1939-40 and in general higher during 1942-43 than during the other seasons, while the average total acid was generally lower during 1939-40 and 1941-42 than during 1940-41 and 1942-43. Differences in fertilization and cultural practices could hardly account for the seasonal variations found, since the management of an individual grove was reasonably uniform. However, a review of the climatological data for the 4 years of this investigation reveals some unusual and extreme weather conditions, which it is believed may have accounted for the differences in the results for the different seasons. A yearly general summary of the climatological data for Florida has been published by the United States Weather Bureau (29, 30, 31, 32). Some of these data are presented in table 2.

⁸ Tentative designation subject to official correlation by Division of Soil Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering.

TABLE 2.—*Climatological data for Florida, south Florida, and various localities in the State, 1939-43*

Year	Average annual temperature							Annual precipitation							Average days rainy (0.01 inch or more)	Average clear days	Literature citation
	Davenport	Orlando	Fort Pierce	Bradenton	Homestead	South Florida	Florida	Davenport	Orlando	Fort Pierce	Bradenton	Homestead	South Florida	Florida			
1939-----	° F. 74.3	° F. 72.3	° F. 72.6	° F. 72.6	° F. 74.0	° F. 73.8	° F. 71.6	In. 61.77	In. 52.42	In. 44.13	In. 54.63	In. 64.04	In. 54.22	In. 54.54	No. 108	No. 158	(29)
1940-----	71.9	69.8	73.0	70.6	71.9	71.7	69.2	49.32	54.02	50.29	48.05	70.37	52.68	52.31	103	150	(30)
1941-----	73.4	70.3	74.2	71.8	72.9	73.2	70.9	62.09	59.65	73.43	48.01	76.47	59.68	58.73	116	139	(31)
1942-----	73.4	71.7	73.6	71.6	72.7	73.0	70.6	50.72	41.29	47.46	47.81	63.31	50.82	53.36	107	158	(32)

ANALYSES OF VARIOUS PHYSICAL CHARACTERS

COLOR OF RIND

The color of the grapefruit rind was determined by matching it with one of the standard colors shown in plate 4. Each sample was

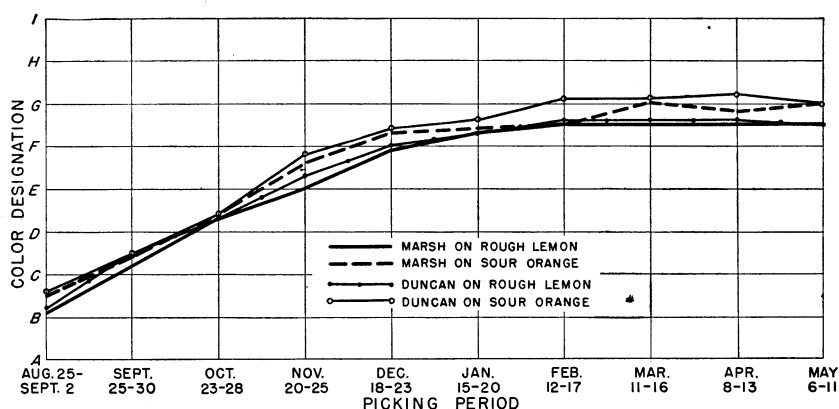


FIGURE 8.—Seasonal changes in the average color of the rind of Marsh and Duncan grapefruit on rough lemon and sour orange rootstocks, 1939-43. (See pl. 4 for color designations.)

fairly uniform in color. Nevertheless, individual values were determined for the 25 grapefruits that comprised each sample, and from these an average was obtained. The results are presented in figure 8 and in tables 13 to 33, Appendix.

Degreening of grapefruit was associated with the ripening of the fruit. This process occurred naturally while the fruit was on the tree, and practically all the fruit had degreened by January or February. After the fruit was degreened, little change was found in the color of the rind through the remainder of the season. The average of the results showed that during 1942-43 degreening was earlier and that the fruit had a better rind color than during the preceding seasons. During 1941-42 the process of degreening was retarded.

The color of the rind was a slightly deeper yellow when the fruits were from trees on sour orange rootstock.

Individual groves showed variation in the color of the rind from one season to another. Variation among groves was also noted. The variation among groves of the same variety and rootstock was about the same as the variation within groves, except for Duncan fruit on rough lemon rootstock. The color of the rind varied more from season to season within groves than it did among the several groves during the same season.

Tests were made during two seasons on the Foster and the Thompson varieties of grapefruit. The Foster fruits showed practically no seasonal variation, but the Thompson showed considerable variation. In general, the Foster grapefruit appeared to have slightly greener rind than either the Marsh or the Duncan fruit for the same seasons. The Thompson variety had a greener rind during 1941-42, but it was more yellow during 1942-43 than either Marsh or Duncan fruit for the same season.

WEIGHT OF FRUIT

The average weight increased gradually with the development and the ripening of the fruit. In general, the weight per fruit was greater for 1939-40 and 1941-42 than for 1940-41 and 1942-43. In September immature Marsh grapefruit showed an average weight of about 270 gm. per fruit; in May, when the fruit was very ripe, it had increased to about 620 gm. During the same period immature Duncan grapefruit averaged about 315 gm. per fruit and very ripe fruit about 715 gm. Less seasonal variation was found in the Marsh than in the Duncan grapefruit. In the Duncan variety considerable variation in weight occurred from one season to another, especially when the fruit was on sour orange rootstock. The summary of results is presented in figure 2 and tables 13 to 33, Appendix.

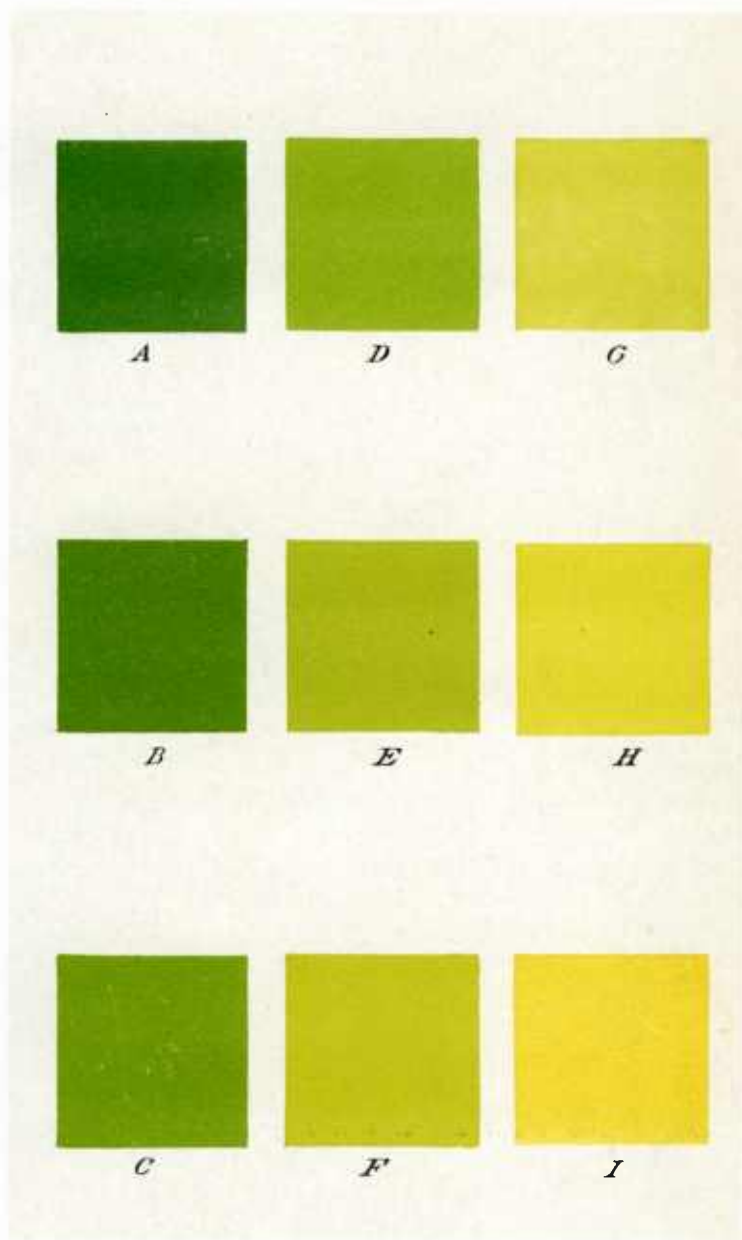
The average weight per fruit was affected only slightly by the rootstock, but the effect was more apparent in the Duncan than in the Marsh, fruit grown on rough lemon being heavier than that on sour orange, especially in the earlier pickings; later in the same season this effect was not so pronounced.

DIAMETER OF FRUIT

There was a consistent increase in the diameter of the fruit during its growth. The greatest increase in size preceded the attainment of prime eating condition. After the fruit was ripe, the increase in diameter was less rapid. The yearly diameter averages and the summary of results showed that the fruits were smaller during 1940-41 than during 1941-42, with the exception of the Marsh on sour orange rootstock. The summary of results is presented in figure 9. On a volume basis the fruit increased in size about 15 percent during the period from mid-December to mid-March. Rootstock did not greatly affect the size of the fruit; but variety did, Duncan being larger than Marsh. The fruit of the Foster variety ranged slightly larger than that of the Duncan. That of Thompson was about the same size as Marsh. (See tables 13 to 33, Appendix.)

THICKNESS OF RIND

Measurements were made to determine the thickness of the rind of the fruit throughout the various stages of development and ripen-



Standards for determining the color of grapefruit rind.



ing. Usually the rind was 1 to 2 mm. thicker during immaturity and senility than it was during the period of prime eating condition. There also were some indications of seasonal behavior, since the average thickness of the rind was slightly greater during 1939-40 than during 1940-41 and 1941-42.

The fruit had slightly thicker rinds when the trees were on rough lemon rootstock, and especially when these trees were grown in the light, sandy soils of the ridge district, than those grown on the heavier soils of the east and west coast districts. The rind thickness of fruit grown on the light, sandy soils ranged from 7 to 11 mm., while that of the others usually ranged from 5 to 7 mm., as shown in tables 13 to 31, Appendix, for Duncan and Marsh varieties.

The results obtained for the Foster and Thompson varieties grown in the same districts were similar to those for the Marsh and Duncan (tables 32 and 33, Appendix).

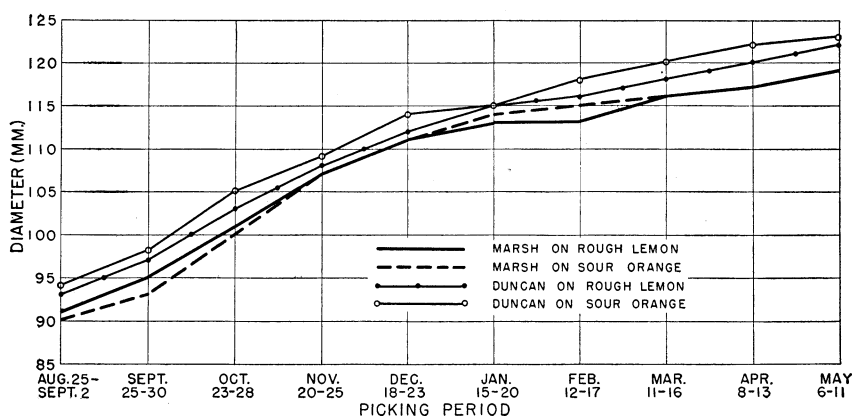


FIGURE 9.—Seasonal changes in the average diameter of Marsh and Duncan grapefruit on rough lemon and sour orange rootstocks, 1939-42.

TEXTURE OF FLESH

Throughout this investigation the fruits of each sample were halved transversely, and the texture of the flesh was classified. No abrupt changes in texture were noted as the fruit matured. However, the flesh texture was distinguished at certain stages as: (1) Ricey-textured, in which the flesh had a ricelike appearance and the juice vesicles contained very small quantities of juice; (2) coarse-textured, in which the vesicle cell walls were thick and conspicuous and the juice vesicles were not distended with juice; and (3) good-textured, in which the vesicle cell walls were thin and inconspicuous and the juice vesicles were fully expanded. The texture of the flesh of individual grapefruits and of composite fruit samples was classified accordingly.

Immature grapefruit was ricey and that picked between November and January was usually coarse, but that picked after January or February had good texture. (See fig. 2 and tables 13 to 33, Appendix.) Granulation or drying out did not develop to any serious extent, although the study was continued each season until the middle of May. In January 1940 a freeze damaged fruit and trees in some of the experimental plots. In each sample the percentage of fruit that

showed freezing injury was ascertained, and this is shown in tables 13, 15, 17, 21, 22, 24, 27, 28, 29, 31, and 32, Appendix.

The fruit developed good texture earlier during 1939-40 than during the three succeeding seasons; the development of good texture was retarded during 1941-42. Rootstock had no marked effect on the texture of the flesh of ripe fruit, but the results summarized in figure 2 show that the immature fruit had slightly better texture when it was grown on sour orange rootstock. There was no marked difference in the texture of the different varieties of fruit from different groves.

COLOR OF FLESH

Progressive changes in the color of the flesh were determined by observing periodically halves of transversely cut grapefruit. The results are presented in figure 10 and in tables 13 to 33, Appendix. It

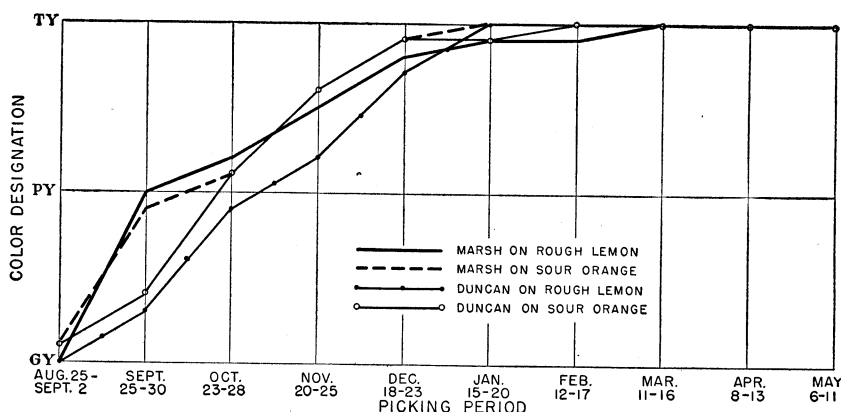


FIGURE 10.—Seasonal changes in the average color of the flesh of Marsh and Duncan grapefruit on rough lemon and sour orange rootstocks, 1939-43. (GY, greenish yellow; PY, pale yellow; TY, tannish yellow.)

was found that the flesh of immature fruit was greenish yellow, that of coarse-textured fruit usually pale yellow, and that of good-textured, ripe fruit tannish yellow. Thus, the flesh was usually greenish yellow during September and October, pale yellow during November and December, and tannish yellow throughout the remainder of the harvest season. In Florida small quantities of early grapefruit are marketed during October and November and very large scale commercial shipments move to market between December and May. During the period of heaviest shipments, therefore, the fruit has good flesh color and texture.

Rootstock on which the trees were grown had no significant effect on the color of the flesh of ripe fruit. Differences in flesh color of fruit from groves on the same kind of rootstock also were negligible.

The color of the flesh of Foster and Thompson grapefruit was pink. (See tables 32 and 33, Appendix.) The deepest color developed during midseason, but there was a tendency for the color to fade to pale pink in ripe or very ripe fruit.

VOLUME OF JUICE

Two different methods were used in extracting the juice from grapefruit during the course of this investigation. During 1939-40 a hand press was employed (fig. 6), but it did not prove very satisfactory because of the difficulty of removing all the juice; therefore, during the last three seasons an electric reamer (fig. 7) was used. Although no difficulty was encountered in removing all the pulp and juice from the grapefruit halves with the reamer, no very fast or efficient method was devised for separating the juice from the pulp. The method employed was to remove the pulp and juice from each individual grapefruit and then strain the juice through a double thickness of cheesecloth, applying hand pressure to force the juice through. This probably produced some irregularities in the data on the volume of juice, and the results must be regarded as approximate rather than exact.

The volume of juice was determined separately for each of the 25 grapefruits in each sample, and the results were computed in terms of milliliters of juice per 100 gm. of fruit, as shown in tables 13 to 33, Appendix, and in figure 2.

Immature fruit contained comparatively small quantities of juice. As the fruit ripened, the volume of juice increased. The most rapid increase occurred in September and October. During this period the volume increased from about 30 ml. per 100 gm. of fruit to about 43 ml. Later in the season the volume of juice in ripe fruit remained rather constant.

The summary of the findings indicates that, on the basis of milliliters of juice per 100 gm. of fruit, variety had some influence. Marsh fruits consistently contained more juice than the Duncan. The increases ranged from 2 to 4 ml. of juice per 100 gm. of fruit. This slightly greater volume was undoubtedly due to the practically seedless character of the Marsh variety. Rootstock apparently did not influence the juice content of the fruit, since the differences found were small and irregular.

PALATABILITY OF FRUIT

The summary of results presented in figure 2 shows that the flavor of immature grapefruit was not significantly influenced by variety or rootstock. However, better flavor was found in ripe fruit from Marsh and Duncan trees on sour orange rootstock.

In general, different investigators agree regarding the relation of rootstock to fruit quality. Harding, Winston, and Fisher (14) showed that the rootstocks on which orange trees were grown influenced the composition and quality of the fruit. Brooks⁹ found that the effect of rootstocks was greater in oranges than in grapefruit and concluded that sour orange stock produced fruit of somewhat higher quality than rough lemon. Camp (5) showed that acceptable fruit of good to excellent quality could be produced on rough lemon stock on light, sandy soils if proper use was made of the available information on citrus nutrition. Under similar conditions sour orange rootstock could still be depended upon to produce somewhat better fruit, but the superiority would be in degree only. Previously Camp and Jefferies (6)

⁹ BROOKS, R. L. A COMPARISON OF CITRUS FRUITS GROWN ON VARIOUS ROOTSTOCKS. [Unpublished thesis. Copy on file at Univ. of Fla., Gainesville.]

reported that rough lemon stock commonly produced two or three times as much fruit as sour orange, but that it was somewhat poorer in quality.

Ripe Marsh and Duncan grapefruit on sour orange rootstock were rated of equal quality, but on rough lemon rootstock the Duncan was rated superior to the Marsh. (See tables 13 to 33, Appendix.)

The flavor of grapefruit was more uniform during 1939-40, 1940-41, and 1941-42 than during 1942-43. During the last-named season the fruit was rated lower between September and January or February than during the preceding seasons. However, from February to May the quality of the fruit of the 1942-43 crop surpassed that of the other seasons, apparently because of greater quantities of total solids and total acid found in the fruit during that season. During certain crop years there was evidence that a deterioration in quality occurred late in the season in very ripe fruit, this being more common in the Marsh than in the Duncan variety.

The progressive improvement in the flavor of Marsh and Duncan grapefruit with maturity and ripening of the fruit on the tree is shown in figures 1 and 2 and in tables 13 to 33, Appendix. In figure 2 three distinct periods of maturity and ripening, A, B, and C, are indicated:

PERIOD A.—The fruit was immature during September and October, and the flavor was very acid or acid to taste. The improvement in flavor was very rapid during this period and showed an increase in numerical values from a range of 20 to 23 to one of 54 to 60.

PERIOD B.—The fruit matured and ripened from November to the middle of February, and the flavor was rated as tart, pleasantly tart, and pleasantly tart to sweet. During period B the flavor ratings did not increase as rapidly as they did during period A; however, an improvement in the flavor occurred as shown by the numerical increase from a range of 54 to 60 to one of 78 to 93. During this period the grapefruit attained sufficient palatability to meet the minimum arbitrary standard of consumer approval as determined by the average numerical flavor ratings. The averages computed from all the fruit samples and for the four crop years indicated that early grapefruit attained satisfactory eating quality by about the first of December. In this connection it should be pointed out that the fruit from individual groves varied as to the date of maturity, based on flavor ratings. This information is shown in tables 13 to 33, Appendix.

PERIOD C.—The fruit was in prime eating condition from February to May, and the flavor was classified as pleasantly tart and pleasantly tart to sweet. During period C changes in flavor were less rapid than in period A or B. The Marsh on rough lemon rootstock increased in flavor until April but decreased slightly in May; Marsh fruit on sour orange rootstock showed no significant change until April and a decrease in flavor in May; Duncan grapefruit on both rough lemon and sour orange rootstock gradually increased in flavor throughout the entire season.

ANALYSES OF CHEMICAL CONSTITUENTS

ASCORBIC ACID

In view of the importance of the vitamin content of grapefruit in determining its dietetic value, the data herein presented are of particular interest. The highest amounts of ascorbic acid per unit of juice were always found in immature grapefruit. As the fruit ripened, the milligrams of ascorbic acid per milliliter (concentration) of juice gradually decreased; and the lowest values were usually found late in the season. However, on the basis of total ascorbic acid per grapefruit the tendency was for the ascorbic acid to increase with the ripening of the fruit, as the volume of juice increased during this period.

Seasonal variations in the ascorbic acid concentration of the grapefruit within and among groves were comparatively small and irregular, as shown in tables 13 to 33, Appendix.

The data obtained on the ascorbic acid concentration are in fairly close agreement with those reported by French and Abbott (11). These investigators analyzed oranges and grapefruit grown in the north, central, and east coast citrus districts of Florida and reported that the range of values for vitamin C seemed to bear no relation to the district where the fruit was produced. They concluded that this indicated that climatic or geographic features within the section studied were not factors of importance. However, certain other factors which affect the ascorbic acid content have been reported. Harding and Thomas (13) determined the ascorbic acid concentration for 390 individual grapefruits picked from outside and inside branches. Their results show that Florida grapefruit from various sources has high ascorbic acid content and that the concentration is highest in the outside fruit. As a result of studies in Arizona, Jones et al. (18) stated that it is consistently evident that the fruit from trees handled to give a low nitrogen content at harvest are higher (approximately 20 to 25 percent) in ascorbic acid concentration than that from trees in which a higher nitrogen level prevailed. Differences of the same order were observed at each harvest throughout the season.

The rootstock on which the grapefruit were grown affected slightly the concentration of ascorbic acid found in the fruit. On the basis of milligrams of ascorbic acid per milliliter of juice, the amount was slightly greater when Marsh and Duncan fruit were on sour orange than when on rough lemon rootstock. In ripe grapefruit very little difference was found in the concentration of ascorbic acid of the Marsh fruit on sour orange and of the Duncan fruit on rough lemon and sour orange rootstocks; however, a slightly lower average ascorbic acid concentration was found in the Marsh grapefruit on rough lemon rootstock (fig. 2).

The ascorbic acid results obtained from the pink varieties, Thompson and Foster, were similar to those from Marsh and Duncan fruit grown under comparable conditions.

TOTAL ASH

Grapefruit juice is acid in reaction because of the presence of organic acids, chiefly citric acid. The juice is also rich in mineral salts in which the basic elements predominate. Because the organic acids are destroyed in the process of digestion in the human alimentary tract, the final reaction of the juice is determined by its mineral content. As the basic elements predominate, grapefruit juice is regarded as a potentially basic, or alkaline, food.

The percentage of ash in the juice of grapefruit was determined during three seasons, 1939-42, and the results are shown in figure 11 and in tables 13 to 33, Appendix.

The ash content of the juice was generally highest in immature fruit picked about September 1 and gradually decreased as the fruit developed and ripened. In ripe fruit the percentages of ash showed little change, although there were indications of a slight increase in very ripe fruit tested in April.

The findings showed very little seasonal variation in the ash content of Marsh fruit on sour orange stock, but more variation occurred in the Marsh on rough lemon and the Duncan on both rootstocks. Generally the percentage of ash was highest during 1940-41 and lowest during 1941-42.

Duncan fruit consistently contained a greater percentage of ash in the juice than did the Marsh. Rootstock exerted little effect on the ash content of Duncan fruit; however, in the Marsh variety the percentages of ash were consistently slightly higher when the fruit was on sour orange rootstock.

CONSTITUENTS OF ASH ¹⁰

Fuller et al. (12, p. 4) stated that experts in nutrition are constantly stressing the importance of so regulating the diet that deficiency ailments may be avoided. It was pointed out that one usually thinks of vitamins in this connection, but that it is now recognized that very serious consequences can result from the deficiency of necessary minerals in the diet of man and animal. It has long been known, for example, that calcium and phosphorus are required for the development of bones, that body fluids need a certain concentration of common salt, and that there must be iron in the blood if it is to carry oxygen.

Determinations of the principal constituents of the ash of the flesh of grapefruit from 14 experimental plots were made at intervals during the harvesting season of 1941-42. During the course of the investigation no attempt was made to change the customary fertiliza-

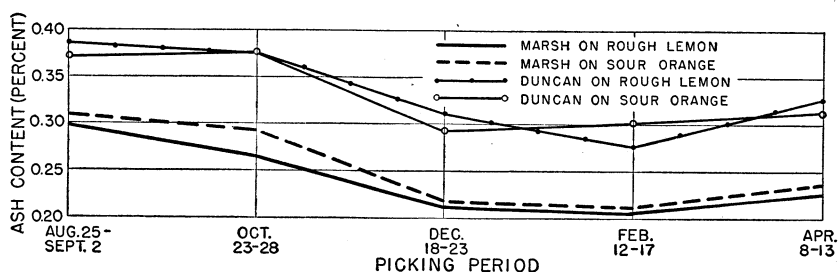


FIGURE 11.—Seasonal changes in the average total ash content of Marsh and Duncan grapefruit on rough lemon and sour orange rootstocks, 1939-42.

tion program. Variations occurred in specific ash constituents. Presumably these variations were the result of lack of uniformity in the time of application of commercial fertilizers.

For convenience, the findings have been grouped according to variety and rootstock (table 3). The respective averages are presented, and the discussion of results is based on them. However, the variations among groves and picking periods are such that the small differences found between varieties and rootstocks are of doubtful nutritive or statistical significance. The fruit of the Duncan variety contained a greater content of potassium than that of the Marsh variety. The fruit of both contained a slightly greater amount of potassium when on sour orange rootstock. Indications point to a greater content of calcium and magnesium and in some cases of potassium in the fruits picked in November as they approached legal maturity than in those picked in May, when the fruit was very ripe. Rootstock and variety had little if any effect on the content of calcium and magnesium in the fruit.

¹⁰ The authors are indebted to W. R. Roy, associate biochemist, Division of Fruit and Vegetable Crops and Diseases, for his advice and generous assistance in obtaining the results on ash constituents.

TABLE 3.—Seasonal changes in some of the principal ash constituents in the flesh of Florida grapefruit, 1941-42

[Each value based on fresh weight of 30 to 40 fruits]

Variety, rootstock, and location	Potassium			Calcium			Magnesium			Phosphorus			Manganese			Iron		
	Nov. 20-25, 1941	Feb. 12-17, 1942	May 6-11, 1942	Nov. 20-25, 1941	Feb. 12-17, 1942	May 6-11, 1942	Nov. 20-25, 1941	Feb. 12-17, 1942	May 6-11, 1942	Nov. 20-25, 1941	Feb. 12-17, 1942	May 6-11, 1942	Nov. 20-25, 1941	Feb. 12-17, 1942	May 6-11, 1942	Nov. 20-25, 1941	Feb. 12-17, 1942	May 6-11, 1942
Marsh on rough lemon:																		
Davenport	Percent 0.095	Percent 0.099	Percent 0.083	Percent 0.014	Percent 0.008	Percent 0.008	Percent 0.012	Percent 0.010	Percent 0.009	Percent 0.012	Percent 0.012	Percent 0.014	Percent 0.016	P. p. m. 0.12	P. p. m. 0.19	P. p. m. 2.7	P. p. m. 4.0	P. p. m. 2.5
Bradenton	.088	.077	.063	.019	.012	.012	.010	.008	.008	.017	.015	.016	.011	.17	.15	3.0	3.2	2.2
Fort Pierce	.084	.084	.....	.016	.011	.013	.011	.008	.010	.015	.015	.016	.03	.11	.26	6.1	6.7	4.2
Homestead	.096	.110	.076	.018	.013	.014	.010	.007	.009	.013	.014	.015	.13	.11	.15	3.4	5.5	4.7
Average	.091	.093	.074	.017	.011	.012	.011	.008	.009	.014	.014	.015	.11	.13	.19	3.8	4.9	3.4
Marsh on sour orange:																		
Davenport	.126	.125	.119	.015	.010	.011	.011	.009	.010	.013	.012	.012	.14	.11	.15	2.5	3.5	2.5
Bradenton	.108	.104	.130	.019	.012	.015	.012	.009	.011	.019	.019	.021	.16	.17	.24	2.4	2.4	6.2
Vero Beach	.093	.109	.100	.021	.010	.011	.011	.007	.011	.016	.016	.016	.20	.16	.10	5.6	2.3	4.1
Homestead	.095	.094	.080	.018	.014	.013	.009	.008	.007	.013	.013	.013	.13	.15	.16	4.0	3.3	4.4
Average	.106	.108	.107	.018	.012	.013	.011	.008	.010	.015	.015	.016	.16	.15	.16	3.6	3.0	4.3
Duncan on rough lemon:																		
Davenport	.142	.116	.142	.018	.009	.011	.013	.....	.010	.013	.012	.013	.04	.03	.19	2.2	3.0	2.0
Palmetto	.128	.112	.118	.026	.014	.016	.011	.010	.010	.016	.016	.018	.18	.15	.21	4.0	5.2	4.2
Fort Pierce	.113	.123	.120	.017	.010	.011	.018	.009	.010	.017	.017	.016	.17	.10	.10	5.8	3.7	5.7
Average	.127	.117	.127	.020	.011	.013	.014	.010	.010	.015	.015	.016	.13	.09	.17	4.0	4.0	4.0
Duncan on sour orange:																		
Davenport	.131	.122	.147	.015	.011	.011	.012	.010	.010	.013	.012	.014	.11	.15	.18	1.4	3.2	2.1
Palmetto	.115	.128	.111	.024	.014	.012	.012	.010	.011	.014	.014	.016	.14	.14	.16	4.3	5.0	5.3
Vero Beach	.178	.128	.127	.022	.014	.014	.013	.008	.011	.018	.019	.017	.19	.21	.24	6.4	7.0	3.8
Average	.141	.126	.128	.020	.013	.012	.012	.009	.011	.015	.015	.016	.15	.17	.19	4.0	5.1	3.7

Generally, the greatest amounts of manganese were found in the very ripe fruit picked in May. Variety had little if any effect on the content of phosphorus, while usually a slightly greater amount of manganese occurred in both the Marsh and the Duncan variety on sour orange rootstock.

The content of iron varied and showed no definite trend. The greater amounts were found in Marsh grapefruit on rough lemon rootstock at Fort Pierce and in the Duncan fruits on sour orange at Palmetto and Vero Beach; smaller amounts of iron were found in the grapefruit grown at Davenport.

PECTIC CONSTITUENTS ¹¹

Analyses were made to determine the seasonal changes in soluble pectin, protopectin, and middle-lamella pectin in the flesh of grapefruit. The fruit consisted of Marsh and Duncan varieties, and the trees were on rough lemon rootstock in the experimental plots located at Lake Hamilton, Fla. Samples for analyses were taken on five dates during the season and represented various stages of fruit maturity and ripening.

Table 4 shows that the pectic constituents undoubtedly are closely associated with the physical condition and maturity of the fruit.

TABLE 4.—*Seasonal changes in soluble pectin, protopectin, and middle-lamella pectin in the flesh of Marsh and Duncan grapefruit on rough lemon rootstock at Lake Hamilton, Fla., 1941-42*

Variety and date of picking	Soluble pectin	Protopectin	Middle-lamella pectin
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Marsh:			
Sept. 2, 1941.....	0.163	0.444	0.040
Oct. 27, 1941.....	.272	.238	.029
Dec. 22, 1941.....	.029	.190	.010
Feb. 16, 1942.....	.008	.028	.039
Apr. 13, 1942.....	.009	.020	.024
Duncan:			
Sept. 2, 1941.....	.092	.401	.045
Oct. 27, 1941.....	.210	.207	.019
Dec. 22, 1941.....	.040	.181	.015
Feb. 16, 1942.....	.010	.040	.023
Apr. 13, 1942.....	.012	.002	.005

The greatest amounts were found in the most immature fruit. A very consistent decrease in pectic substances may be noted with the ripening of the fruit on the tree, particularly in protopectin. Except for the fruit picked October 27, the results obtained for soluble pectin are likewise consistent throughout the year. The middle-lamella pectin was found to be more erratic, with a tendency to decrease.

ACTIVE ACIDITY, OR pH VALUES

Duplicate pH determinations were made at intervals of about 4 weeks on the composited juice of grapefruit for four seasons, 1939-43. A summary of the results appears in figure 12. It was found that the juice of the samples picked between August 25 and September 2 had a slightly higher pH value than those tested in late September or in

¹¹ Acknowledgment is due E. V. Miller and B. R. Briggs, of the Division of Fruit and Vegetable Crops and Diseases, for their advice and assistance in obtaining the results on pectic constituents.

October. During the commercial shipping season pH values increased gradually and more abruptly in very ripe fruit picked in April and May.

The seasonal variation in pH values was small during 1939-40, 1940-41, and 1941-42, but it was found to be considerably lower during 1942-43.

The summary of results shown in figure 12 indicates that the active acidity of grapefruit juice was influenced more by the variety than by the rootstock on which the trees were grown. Consistently higher pH values were found in the juice of the Duncan than in that of the Marsh fruit. Rootstock had little effect on the pH values of Marsh juice, but in the Duncan variety lower pH values were found when the fruit was on sour orange stock than on rough lemon.

Variation among groves was comparatively small, as shown in tables 13 to 33, Appendix.

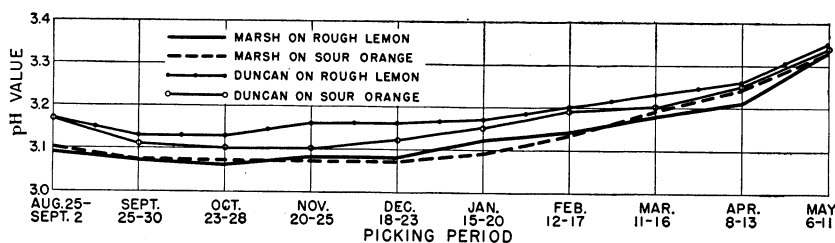


FIGURE 12.—Seasonal changes in the pH values of Marsh and Duncan grapefruit on rough lemon and sour orange rootstocks, 1939-43.

REDUCING SUGARS, SUCROSE, AND TOTAL SUGARS

Reducing sugars increased with the ripening of grapefruit, as is shown in figure 13. The yearly variation in reducing sugars was not great in the Marsh and Duncan varieties, but in the Foster fruit considerable seasonal variation occurred. Usually the smallest amounts of reducing sugars were found in the Marsh fruit tested during 1940-41 and in that of the Duncan during 1941-42. The greatest amounts occurred during 1939-40 in fruit on sour orange rootstock.

Rootstock affected the content of reducing sugars in the fruit. Both the Marsh and the Duncan variety contained more when the trees were on sour orange rootstock. Variety also influenced the amount of reducing sugars; the results showed that the Duncan fruit contained more than the Marsh, when the comparison was made between the fruit from the same rootstock (fig. 13).

Individual groves showed seasonal variation in the amounts of reducing sugars found in the fruit. There was also variation among groves; the variation among groves on the same kind of rootstock was about the same as that found within groves.

Sucrose usually increased during the fall months, remained rather constant during midseason, and decreased sharply between February and April (fig. 13). In 1913 Collison (8) found that sugars increased during ripening and after the fruit became mature there was a noticeable increase in reducing sugars with a corresponding decrease in sucrose, pointing to a breaking down of sucrose into dextrose and fructose.

The seasonal variation in sucrose was much greater than that found in the reducing sugars. The smallest amounts of sucrose were found during 1939-40 in the Marsh fruit and during 1940-41 in the Duncan fruit. Sucrose increased only slightly with the ripening of Thompson

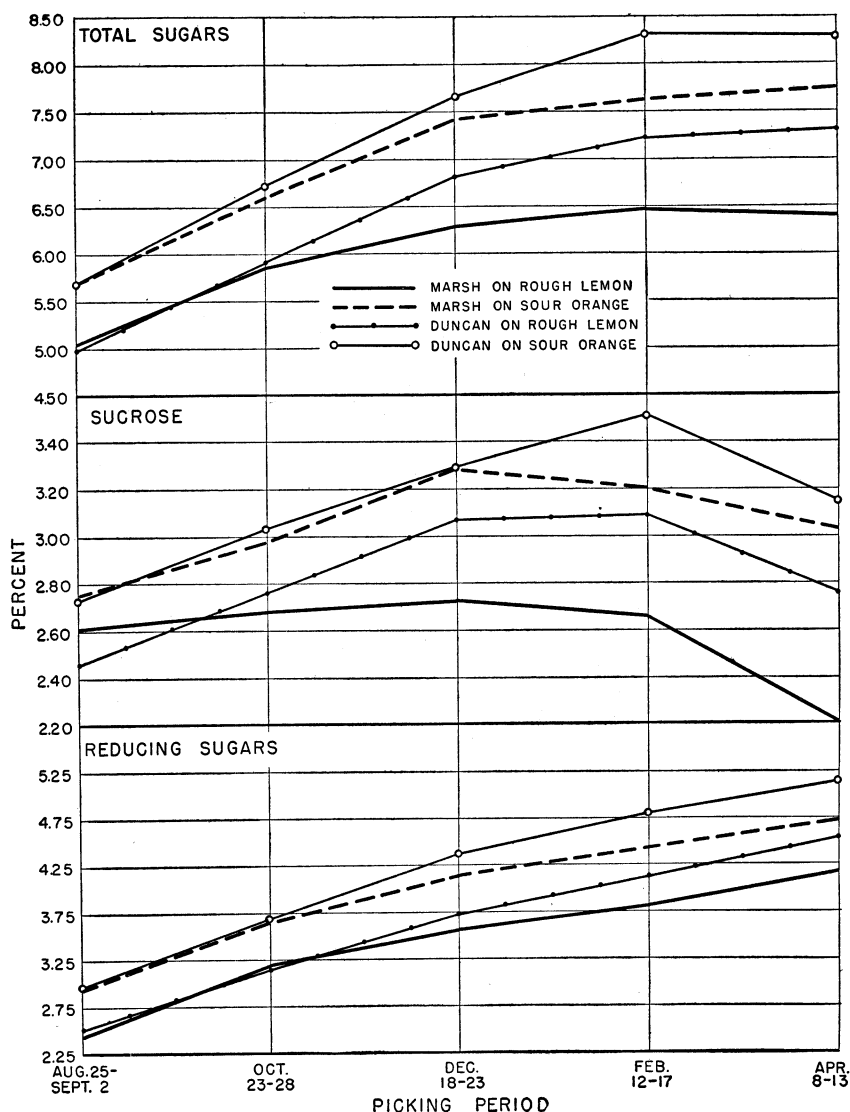


FIGURE 13.—Seasonal changes in reducing sugars, sucrose, and total sugars of Marsh and Duncan grapefruit on rough lemon and sour orange rootstocks, 1939-42.

grapefruit and, in general, the seasonal trend was low. In the Foster variety a very high sucrose content was found. The seasonal variation was wider and the amounts of sucrose were greater during 1940-41 than during 1939-40.

Greater amounts of sucrose occurred in the fruit on sour orange than on rough lemon rootstock. Likewise, Duncan fruit contained more sucrose than the Marsh when the trees were on the same kind of rootstock (fig. 13). A considerable variation was found from one season to another, as well as among different groves for the same season. These results were more pronounced for sucrose than for the reducing sugars.

It will be noted from figure 14 that total sugars usually increased in the Marsh and Duncan fruit during the fall and midseason but showed a tendency to remain rather constant in ripe fruit. The exception to this was the 1940-41 season, when there was a gradual increase in total sugars during the entire season. Seasonal variation in total sugars was moderate, and the amount was influenced by the yearly amounts of reducing sugars and sucrose that made up the total sugars.

Tests on the Foster variety were made during two seasons. The results showed that the fruit contained a greater content of total sugars during 1939-40 than during 1940-41. Thompson fruit tested for one season only contained smaller amounts of total sugars than the Marsh under comparable conditions.

TOTAL SOLIDS

The total solids (principally sugars) generally increased slightly during the earlier stages of maturity. After the fruit was ripe there was a tendency for the total solids content to remain more or less constant, but very late in the season it frequently decreased. (See fig. 2 and tables 13 to 33, Appendix).

The results for grapefruit reported herein, as well as those for Florida oranges (14), are in general agreement with the findings of Chace and Church (7), who reported that soluble solids increased from month to month, that the acidity of the juice decreased, and that these changes in composition took place more slowly in grapefruit than in oranges.

Martin (19, 20, 21) pointed out the influence of nitrogen nutrition in altering fall coloration and maturity of Marsh grapefruit. He found that fruit from trees of low nitrogen content in the fall developed yellow color much earlier than that from trees high in nitrogen. At the same time somewhat sweeter fruit, as measured by the solids-acid ratio of the juice, was obtained from trees which were starved for nitrogen by competing cover crops in the summer months and had reduced nitrogen content at the time of fruit maturity.

Figure 14, which shows the yearly averages of total solids, indicates marked seasonal variations. Generally the grapefruit ran low in total solids during 1939-40 and high during 1942-43. Averages for the different variety-rootstock combinations computed for the four seasons, 1939-43, are presented graphically in figure 2.

During the commercial shipping period Marsh grapefruit on rough lemon rootstock averaged slightly over 9 percent total solids and on sour orange, 10.4 percent; Duncan grapefruit on rough lemon, about 10.2 percent, and on sour orange, about 11.6 percent. Rootstock and variety, therefore, exerted a pronounced influence on the amount of total solids found in the fruit. Both Marsh and Duncan on sour orange stock contained greater amounts of total solids. The Duncan fruit contained more solids than the Marsh on both rootstocks.

There was a greater variation in the total solids content of the fruit from one season to another within the same groves than was found

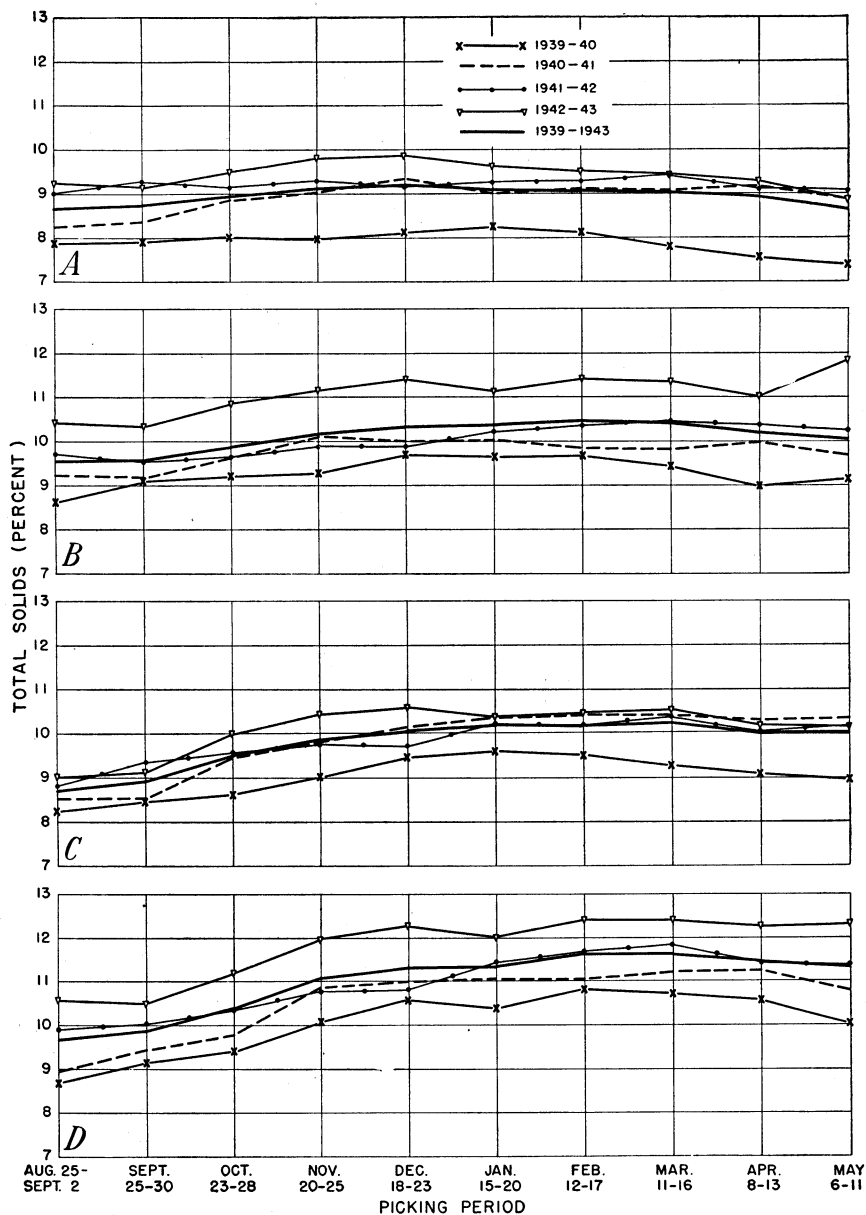


FIGURE 14.—Seasonal changes in average total solids of grapefruit, 1939-43: A, Marsh on rough lemon rootstock; B, Marsh on sour orange; C, Duncan on rough lemon; D, Duncan on sour orange.

among different Marsh and Duncan groves on the same kind of rootstock for the same season. The data on total solids for Marsh

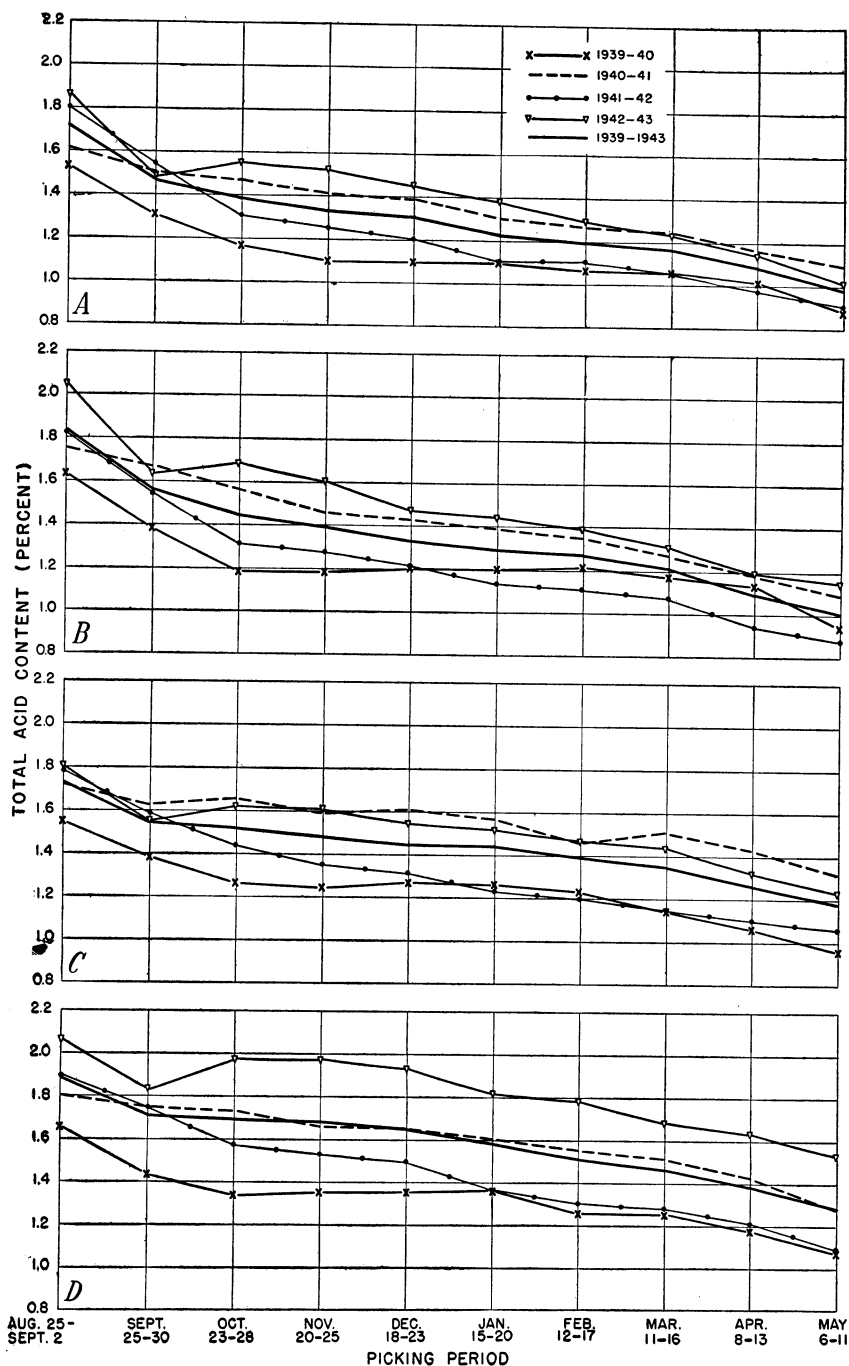


FIGURE 15.—Seasonal changes in average total acid content of grapefruit, 1939-43: A, Marsh on rough lemon rootstock; B, Marsh on sour orange; C, Duncan on rough lemon; D, Duncan on sour orange.

and Duncan grapefruit for 1939-40, 1940-41, and 1941-42 were analyzed statistically, as shown in tables 13 to 33, Appendix.

TOTAL ACID

A downward trend in total acid generally characterized Marsh and Duncan grapefruit as the fruit ripened. Figure 2 shows the summary of results. The average total acid ranged from about 1.70 to 1.89 for immature fruit to about 1 to 1.28 percent for very ripe fruit late in the season.

The seasonal differences were rather pronounced, and the averages were generally lower during 1939-40 and 1941-42 than during 1940-41 and 1942-43 (fig. 15). During 1942-43 unusually high total acid and total solids characterized the fruit in one of the plots. The data are presented in table 56, Appendix, showing that the total acid of the fruit was more than 2 percent during the entire crop year. The total solids content of the fruit was also unusually high, ranging from 11.77 to 14.58 percent. Information obtained through taste tests on this fruit showed that it was rated as acceptable from midseason through the remainder of the season. During the early part of the season the taste ratings were below average, but after midseason they were about average.

When the rootstock was rough lemon there was slightly more variation in the total acid content of the fruit from different groves than in fruit from the same grove. Fruit grown on sour orange rootstock varied little in total acid and showed slightly more seasonal variation within groves.

The amount of total acid found in the fruit was influenced by variety and rootstock, as shown in figure 2; the Duncan consistently had a greater total acid than the Marsh. There was also a greater variation in the Duncan than in the Marsh. Total acid was influenced more by variety than it was by rootstock. However, the grapefruit on sour orange had greater total acidity than that on rough lemon.

The data on the total acid for Marsh and Duncan grapefruit for 1939-40, 1940-41, and 1941-42 (tables 13 to 31, Appendix) were analyzed statistically.

RATIO OF TOTAL SOLIDS TO TOTAL ACID

The solids-acid ratio generally increased with the ripening of the fruit. The increase was primarily due to a diminution in the total acid, since the total solids remained about constant in ripe fruit. Seasonal conditions influenced the yearly average ratios. The highest ratios found were during 1941-42 and the lowest during 1940-41 and 1942-43.

Average ratios were computed for the four seasons, 1939-43, and the results are shown in figure 2. The highest solids-acid ratios were obtained in the Marsh grapefruit grown on sour orange rootstock. Lower ratios were found in fruit from trees on rough lemon. In immature Duncan fruit rootstock did not greatly affect the ratios, but in ripe fruit they were consistently higher from sour orange than rough lemon rootstock.

RELATION OF ARSENICAL SPRAY LAW TO GRAPEFRUIT

The spraying of grapefruit trees with lead arsenate is a common practice in Florida, dating back to the time when the spray was used as a control for insect infestation. It is no longer used for this purpose and the quantity of arsenic applied is sufficient to leave only barely detectable residues, if any at all, on the rind of the fruit at time of harvest. In earlier times, however, when lead arsenate was used for insect control, growers observed that the fruit from sprayed trees contained less acid and seemed sweeter than that from trees not sprayed with lead arsenate; therefore the spray came to be used solely for the purpose of obtaining sweeter fruit. The influence of the arsenate spray in lowering the acidity of the fruit appears to be systemic in the tree and is exerted largely from deposits on the leaves rather than on the fruit. The physiological basis for the effect is still obscure.

Injudicious use of lead arsenate on various types of citrus trees in order to effect an earlier attainment of legal maturity of the fruit prompted the Florida State Legislature to pass the Arsenical Spray Law (22, p. 5), which is briefly described as follows:

AN ACT to Prohibit the Use of Arsenic or Any of Its Derivatives or Any Combination, Compound or Preparation Containing Arsenic, as a Fertilizer or Spray on Bearing Citrus Trees; to Prohibit the Sale or Transportation of Citrus Fruit Containing Any Arsenic; and to Provide for Enforcement Thereof.

In 1929 the Mediterranean fruitfly made its appearance, and arsenic was the only effective poison known at that time for its control. Consequently, an amendment to the Arsenical Spray Law was approved June 29, 1929, giving the Federal Government and the Florida State Plant Board the right to use arsenic for the purpose of eradicating the fruitfly. This amendment prevented the enforcement of the law until January 1, 1931. Between 1929 and 1932 much investigational work was done by the Florida State Department of Agriculture (22) to ascertain the effects of arsenicals on citrus fruits. It was found that the flavor of grapefruit apparently was not lowered by this spray, whereas its injudicious use on oranges and tangerines caused a very marked decrease in total acid and produced flat, insipid, poor-quality fruit. Therefore, in 1933 grapefruit was exempted from the Arsenical Spray Law (10, p. 113), through an "... injunction granted by Circuit Judge H. C. Pettaway . . . and upheld by the Supreme Court, restraining the Department of Agriculture from the enforcement of the Citrus Arsenical Spray Law in the case of grapefruit," so that now this law is applied only to oranges and tangerines.

On this account comprehensive investigations were made to obtain more complete information on the effects of spraying in July with lead arsenate (usually at the rate of 1 pound to 100 gallons) on the composition and internal quality of Marsh and Duncan grapefruit. In tables 5 to 12 the physical characters and chemical constituents of these varieties on rough lemon and sour orange rootstocks when unsprayed and when sprayed with lead arsenate are directly compared and the differences resulting from the spray are shown. The inter-relations of the physical characters and chemical constituents of the individual variety-rootstock combinations when unsprayed and when sprayed with lead arsenate at the different picking periods throughout the season are shown in figures 16 to 19.

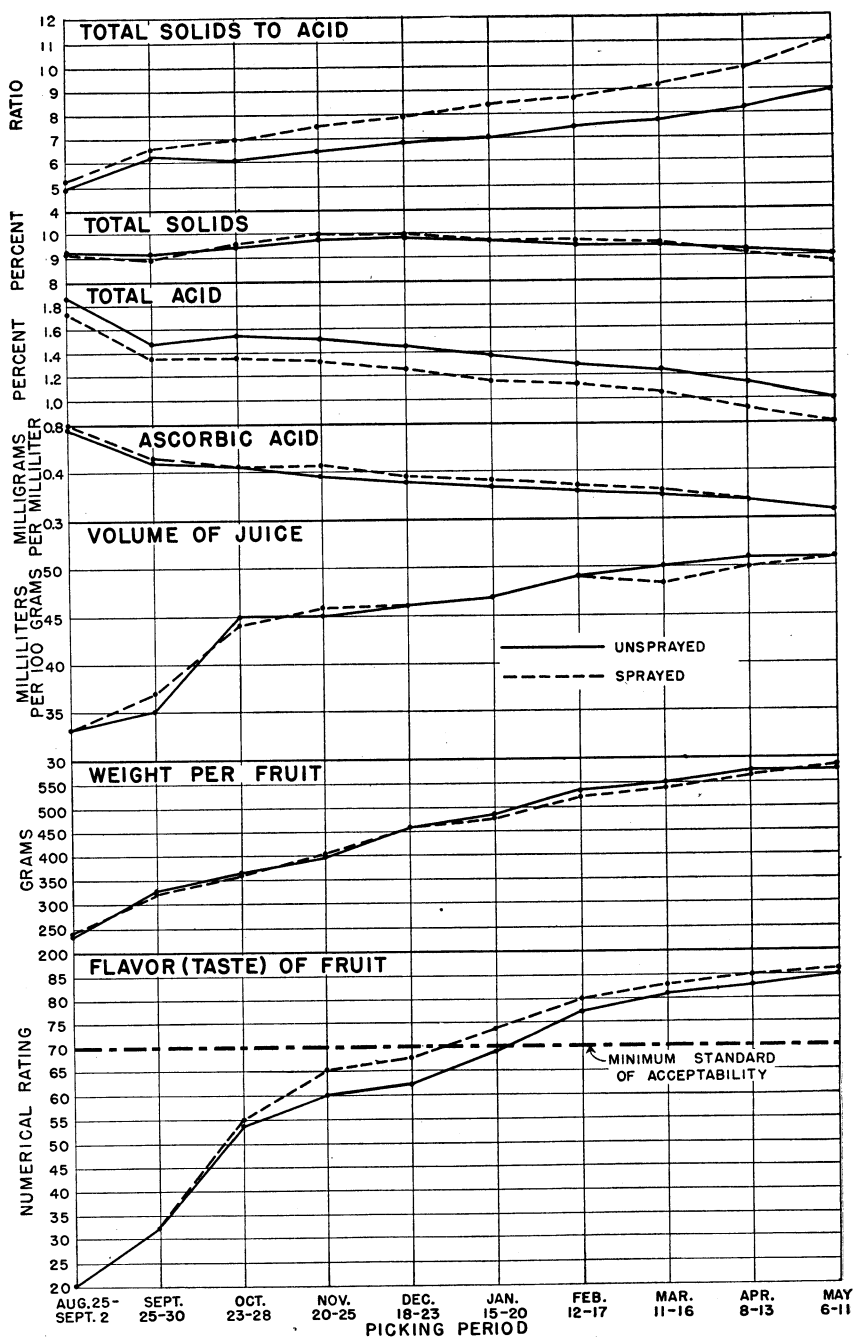


FIGURE 16.—Interrelation of physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock, when unsprayed and when sprayed with lead arsenate (1 pound to 100 gallons), at different picking periods throughout the season. (Averages of all seasons, 1939-43, and all groves.)

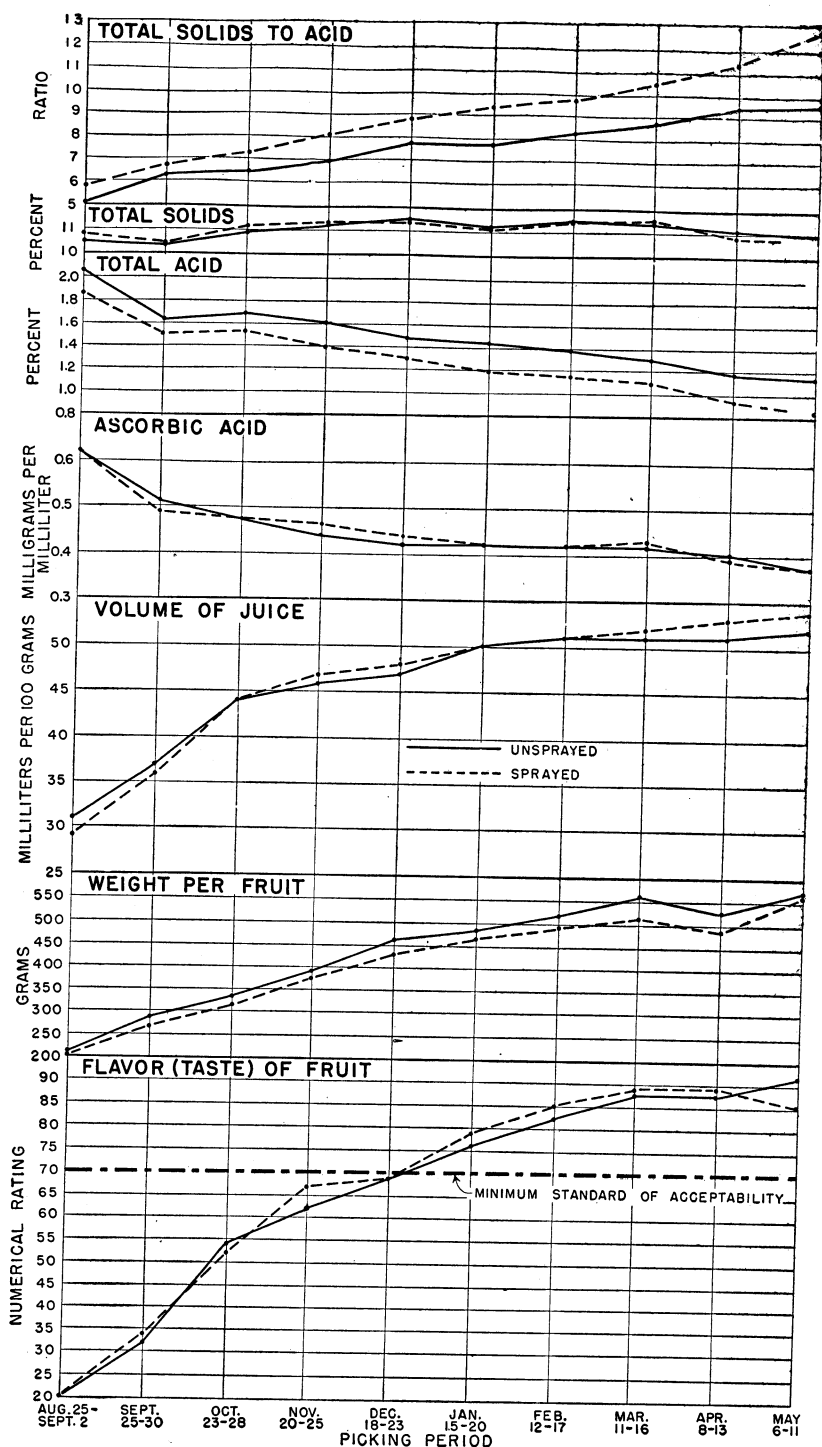


FIGURE 17.—Interrelation of physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock, when unsprayed and when sprayed with lead arsenate (1 pound to 100 gallons), at different picking periods throughout the season. (Averages of all seasons, 1939-43, and all groves.)

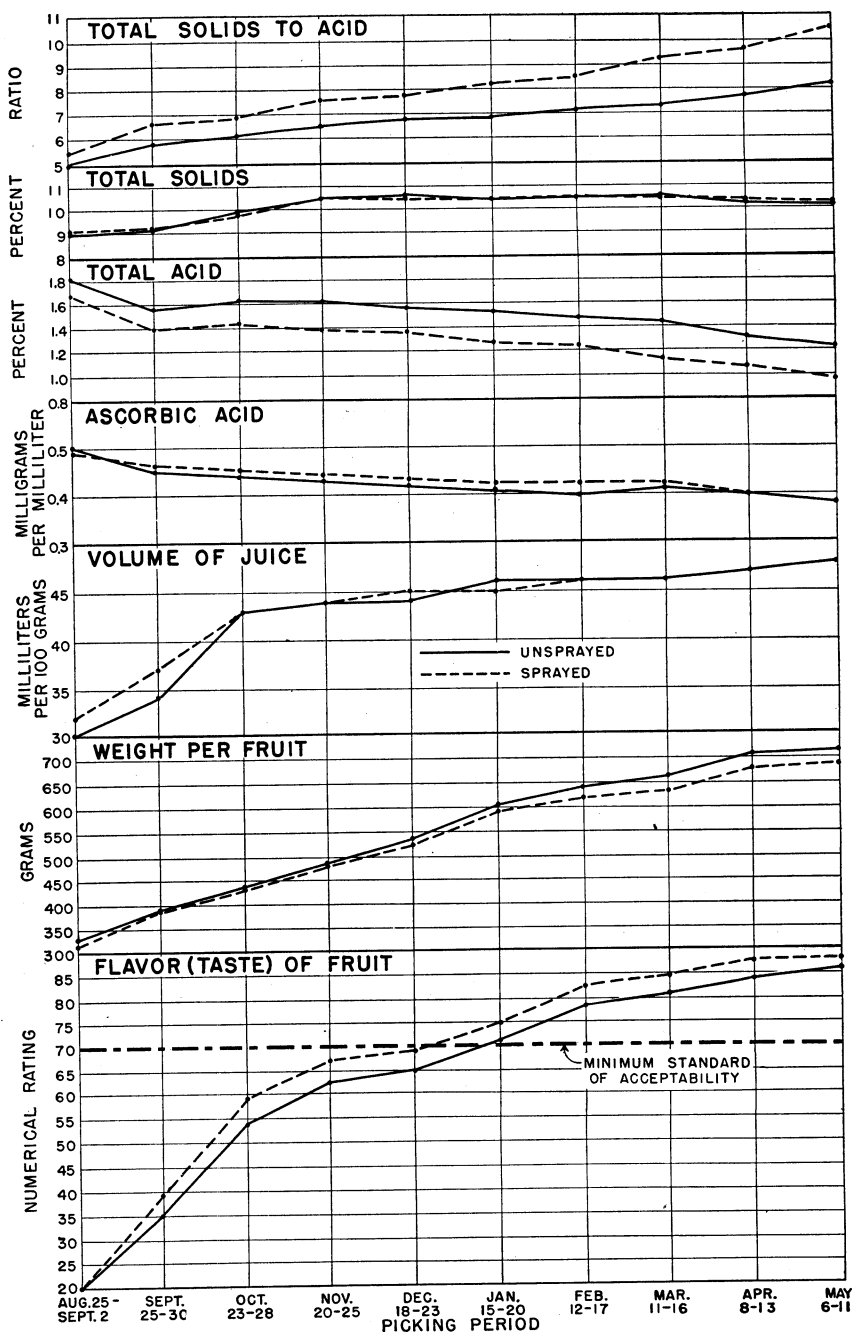


FIGURE 18.—Interrelation of physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock, when unsprayed and when sprayed with lead arsenate (1 pound to 100 gallons), at different picking periods throughout the season. (Averages of all seasons, 1939-43, and all groves.)

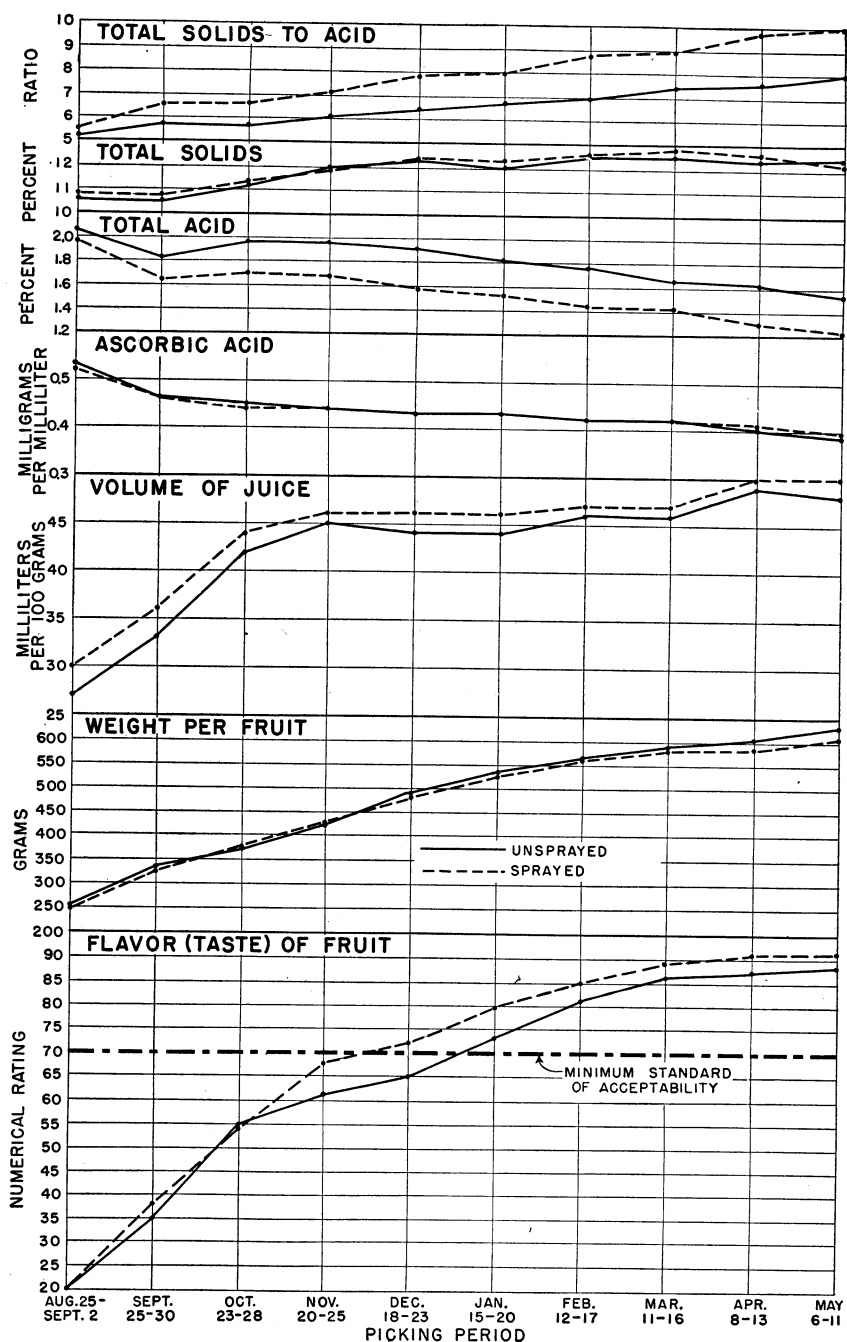


FIGURE 19.—Interrelation of physical characters and chemical constituents of Duncan grapefruit on sour orange rootstock, when unsprayed and when sprayed with lead arsenate (1 pound to 100 gallons), at different picking periods throughout the season. (Averages of all seasons, 1939-43, and all groves.)

TABLE 5.—*Effect of lead arsenate spray on the average weight of grapefruits at different picking periods, 1939-43*

[+ indicates that weight of sprayed fruit was greater than that of unsprayed; — that it was less]

Variety, rootstock, and treatment	Weight per fruit									
	Aug. 25- Sept. 2	Sept. 25-30	Oct. 23-28	Nov. 20-25	Dec. 18-23	Jan. 15-20	Feb. 12-17	Mar. 11-16	Apr. 7-13	May 6-11
Marsh on rough lemon:	<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>	<i>Gm.</i>
Unsprayed.....	238	328	364	399	461	488	535	550	572	579
Sprayed.....	242	321	358	402	463	481	522	541	566	585
Difference.....	+4	-7	-6	+3	+2	-7	-13	-9	-6	+6
Marsh on sour orange:										
Unsprayed.....	210	286	336	393	461	488	521	556	521	561
Sprayed.....	200	266	316	378	431	467	495	511	487	554
Difference.....	-10	-20	-20	-15	-30	-21	-26	-45	-34	-7
Duncan on rough lemon:										
Unsprayed.....	323	392	437	485	539	603	641	662	704	716
Sprayed.....	312	389	430	478	524	592	615	633	677	684
Difference.....	-11	-3	-7	-7	-15	-11	-26	-29	-27	-32
Duncan on sour orange:										
Unsprayed.....	253	337	371	422	491	537	563	589	604	629
Sprayed.....	249	325	373	428	482	527	557	583	584	605
Difference.....	-4	-12	+2	+6	-9	-10	-6	-6	-20	-24

TABLE 6.—*Effect of lead arsenate spray on the average volume of juice in 100 grams of grapefruit at different picking periods, 1939-43*

[+ indicates that sprayed fruit contained a greater volume of juice than unsprayed; — a smaller volume]

Variety, rootstock, and treatment	Juice per 100 grams of fruit									
	Aug. 25- Sept. 2	Sept. 25-30	Oct. 23-28	Nov. 20-25	Dec. 18-23	Jan. 15-20	Feb. 12-17	Mar. 11-16	Apr. 7-13	May 6-11
Marsh on rough lemon:	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>
Unsprayed.....	33	35	45	45	46	47	49	50	51	51
Sprayed.....	33	37	44	46	46	47	49	48	50	51
Difference.....	0	+2	-1	+1	0	0	0	-2	-1	0
Marsh on sour orange:										
Unsprayed.....	31	37	44	46	47	50	51	51	51	52
Sprayed.....	29	36	44	47	48	50	51	52	53	54
Difference.....	-2	-1	0	+1	+1	0	0	+1	+2	+2
Duncan on rough lemon:										
Unsprayed.....	30	34	43	44	44	46	46	46	47	48
Sprayed.....	32	37	43	44	45	45	46	46	47	48
Difference.....	+2	+3	0	0	+1	-1	0	0	0	0
Duncan on sour orange:										
Unsprayed.....	27	33	42	45	44	44	46	46	49	48
Sprayed.....	30	36	44	46	46	46	47	47	50	50
Difference.....	+3	+3	+2	+1	+2	+2	+1	+1	+1	+2

TABLE 7.—*Effect of lead arsenate spray on the average percentage of grapefruit that was juice at different picking periods, 1939-43*

[+ indicates that a greater percentage of sprayed fruit was juice than unsprayed; — a smaller percentage]

Variety, rootstock, and treatment	Juice per fruit									
	Aug. 25- Sept. 2	Sept. 25-30	Oct. 23-28	Nov. 20-25	Dec. 18-23	Jan. 15-20	Feb. 12-17	Mar. 11-16	Apr. 7-13	May 6-11
Marsh on rough lemon:										
Unsprayed.....	Pct. 33	Pct. 36	Pct. 46	Pct. 47	Pct. 47	Pct. 49	Pct. 50	Pct. 51	Pct. 52	Pct. 53
Sprayed.....	33	39	45	48	47	49	50	50	52	53
Difference.....	0	+3	-1	+1	0	0	0	-1	0	0
Marsh on sour orange:										
Unsprayed.....	32	38	45	48	49	52	53	52	52	55
Sprayed.....	30	37	45	49	50	51	52	54	55	56
Difference.....	-2	-1	0	+1	+1	-1	-1	+2	+3	+1
Duncan on rough lemon:										
Unsprayed.....	31	35	45	46	46	47	47	47	48	50
Sprayed.....	32	37	45	45	46	47	48	47	48	50
Difference.....	+1	+2	0	-1	0	0	+1	0	0	0
Duncan on sour orange:										
Unsprayed.....	29	34	44	46	47	46	48	48	51	50
Sprayed.....	31	37	45	48	48	48	49	49	51	52
Difference.....	+2	+3	+1	+2	+1	+2	+1	+1	0	+2

TABLE 8.—*Effect of lead arsenate spray on the average ascorbic acid concentration per milliliter of grapefruit juice at different picking periods, 1939-43*

[+ indicates that ascorbic acid content in sprayed fruit was greater than in unsprayed; — that it was less]

Variety, rootstock, and treatment	Ascorbic acid per milliliter of juice									
	Aug. 25- Sept. 2	Sept. 25-30	Oct. 23-28	Nov. 20-25	Dec. 18-23	Jan. 15-20	Feb. 12-17	Mar. 11-16	Apr. 7-13	May 6-11
Marsh on rough lemon:										
Unsprayed.....	Mg. 0.49	Mg. 0.42	Mg. 0.41	Mg. 0.39	Mg. 0.38	Mg. 0.37	Mg. 0.36	Mg. 0.35	Mg. 0.34	Mg. 0.32
Sprayed.....	.50	.43	.41	.41	.39	.38	.37	.36	.34	.32
Difference.....	+ .01	+ .01	.00	+ .02	+ .01	+ .01	+ .01	+ .01	.00	.00
Marsh on sour orange:										
Unsprayed.....	.62	.51	.47	.44	.42	.42	.42	.42	.40	.37
Sprayed.....	.62	.49	.47	.46	.44	.42	.42	.43	.39	.37
Difference.....	.00	-.02	.00	+ .02	+ .02	.00	.00	+ .01	-.01	.00
Duncan on rough lemon:										
Unsprayed.....	.50	.45	.44	.43	.42	.41	.40	.41	.40	.38
Sprayed.....	.49	.46	.45	.44	.43	.42	.42	.42	.40	.38
Difference.....	-.01	+ .01	+ .01	+ .01	+ .01	+ .01	+ .02	+ .01	.00	.00
Duncan on sour orange:										
Unsprayed.....	.53	.46	.45	.44	.43	.43	.42	.42	.40	.38
Sprayed.....	.52	.46	.44	.44	.43	.43	.42	.42	.41	.39
Difference.....	-.01	.00	-.01	.00	.00	.00	.00	.00	+ .01	+ .01

TABLE 9.—*Effect of lead arsenate spray on the average total solids content of grapefruits at different picking periods, 1939-43*

[+ indicates that total solids content in sprayed fruit was greater than in unsprayed; — that it was less]

Variety, rootstock, and treatment	Total solids									
	Aug. 25- Sept. 2	Sept. 25-30	Oct. 23-28	Nov. 20-25	Dec. 18-23	Jan. 15-20	Feb. 12-17	Mar. 11-16	Apr. 7-13	May 6-11
Marsh on rough lemon:	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>
Unsprayed	9.21	9.11	9.46	9.79	9.85	9.60	9.49	9.40	9.24	9.01
Sprayed	9.13	8.97	9.55	9.97	9.89	9.61	9.60	9.44	9.14	8.83
Difference	-.08	-.14	+.09	+.18	+.04	+.01	+.11	+.04	-.10	-.18
Marsh on sour orange:										
Unsprayed	10.42	10.35	10.86	11.19	11.42	11.15	11.44	11.37	11.03	10.85
Sprayed	10.81	10.39	11.10	11.29	11.39	11.09	11.36	11.45	10.77	10.71
Difference	+.39	+.04	+.24	+.10	-.03	-.06	-.08	+.08	-.26	-.14
Duncan on rough lemon:										
Unsprayed	8.98	9.07	9.94	10.42	10.59	10.35	10.42	10.50	10.17	10.12
Sprayed	9.10	9.15	9.75	10.43	10.44	10.38	10.46	10.41	10.22	10.17
Difference	+.12	+.08	-.19	+.01	-.15	+.03	+.04	-.09	+.05	+.05
Duncan on sour orange:										
Unsprayed	10.59	10.50	11.17	11.99	12.29	12.03	12.43	12.41	12.28	12.32
Sprayed	10.78	10.75	11.34	11.93	12.32	12.24	12.53	12.72	12.54	12.08
Difference	+.19	+.25	+.17	-.06	+.03	+.21	+.10	+.31	+.26	-.24

TABLE 10.—*Effect of lead arsenate spray on the average total acid of grapefruits at different picking periods, 1939-43*

[— indicates that total acid was less in sprayed fruit than in unsprayed]

Variety, rootstock, and treatment	Total acidity									
	Aug. 25- Sept. 2	Sept. 25-30	Oct. 23-28	Nov. 20-25	Dec. 18-23	Jan. 15-20	Feb. 12-17	Mar. 11-16	Apr. 7-13	May 6-11
Marsh on rough lemon:	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>
Unsprayed	1.86	1.48	1.55	1.52	1.45	1.38	1.29	1.23	1.14	1.01
Sprayed	1.73	1.37	1.37	1.33	1.25	1.15	1.12	1.04	.92	.80
Difference	-.13	-.11	-.18	-.19	-.20	-.23	-.17	-.19	-.22	-.21
Marsh on sour orange:										
Unsprayed	2.05	1.63	1.68	1.60	1.47	1.44	1.39	1.31	1.18	1.14
Sprayed	1.86	1.51	1.53	1.39	1.30	1.19	1.16	1.10	.95	.84
Difference	-.19	-.12	-.15	-.21	-.17	-.25	-.23	-.21	-.23	-.30
Duncan on rough lemon:										
Unsprayed	1.81	1.55	1.62	1.61	1.56	1.52	1.47	1.44	1.32	1.23
Sprayed	1.67	1.39	1.43	1.38	1.35	1.27	1.24	1.13	1.06	.97
Difference	-.14	-.16	-.19	-.23	-.21	-.25	-.23	-.31	-.26	-.26
Duncan on sour orange:										
Unsprayed	2.06	1.83	1.97	1.97	1.93	1.81	1.78	1.68	1.63	1.53
Sprayed	1.97	1.65	1.71	1.69	1.59	1.54	1.45	1.42	1.29	1.21
Difference	-.09	-.18	-.26	-.28	-.34	-.27	-.33	-.26	-.34	-.32

TABLE 11.—*Effect of lead arsenate spray on the average ratios of total solids to acid in grapefruits at different picking periods, 1939-43*

[+ indicates that the total solids-to-acid ratio was greater in sprayed fruit than in unsprayed]

Variety, rootstock, and treatment	Solids-acid ratio									
	Aug. 25- Sept. 2	Sept. 25-30	Oct. 23-28	Nov. 20-25	Dec. 18-23	Jan. 15-20	Feb. 12-17	Mar. 11-16	Apr. 7-13	May 6-11
Marsh on rough lemon:										
Unsprayed.....	4.95	6.16	6.10	6.44	6.79	6.96	7.36	7.64	8.11	8.92
Sprayed.....	5.28	6.55	6.97	7.50	7.91	8.36	8.57	9.08	9.93	11.04
Difference.....	+ .33	+ .39	+ .87	+1.06	+1.12	+1.40	+1.21	+1.44	+1.82	+2.12
Marsh on sour orange:										
Unsprayed.....	5.08	6.35	6.46	6.99	7.77	7.74	8.23	8.68	9.35	9.52
Sprayed.....	5.81	6.88	7.25	8.12	8.76	9.32	9.79	10.41	11.34	12.75
Difference.....	+ .73	+ .53	+ .79	+1.13	+ .99	+1.58	+1.56	+1.73	+1.99	+3.23
Duncan on rough lemon:										
Unsprayed.....	4.96	5.85	6.14	6.47	6.79	6.81	7.09	7.29	7.70	8.23
Sprayed.....	5.45	6.58	6.82	7.56	7.73	8.17	8.44	9.21	9.64	10.48
Difference.....	+ .49	+ .73	+ .68	+1.09	+ .94	+1.36	+1.35	+1.92	+1.94	+2.25
Duncan on sour orange:										
Unsprayed.....	5.14	5.74	5.67	6.09	6.37	6.65	6.98	7.39	7.53	8.05
Sprayed.....	5.47	6.52	6.63	7.06	7.75	7.95	8.64	8.96	9.72	9.98
Difference.....	+ .33	+ .78	+ .96	+ .97	+1.38	+1.30	+1.66	+1.57	+2.19	+1.93

TABLE 12.—*Effect of lead arsenate spray on the average flavor, or taste, as indicated by numerical ratings of grapefruits at different picking periods, 1939-43*

[+ indicates increase in flavor in sprayed fruit; - decrease in flavor]

Variety, rootstock, and treatment	Numerical ratings (flavor, or taste)									
	Aug. 25- Sept. 2	Sept. 25-30	Oct. 23-28	Nov. 20-25	Dec. 18-23	Jan. 15-20	Feb. 12-17	Mar. 11-16	Apr. 7-13	May 6-11
Marsh on rough lemon:										
Unsprayed.....	20	32	54	60	62	69	77	81	83	85
Sprayed.....	20	32	55	65	68	74	80	83	85	86
Difference.....	0	0	+1	+5	+6	+5	+3	+2	+2	+1
Marsh on sour orange:										
Unsprayed.....	20	32	54	62	69	76	82	87	87	92
Sprayed.....	20	34	52	67	69	79	85	89	89	85
Difference.....	0	+2	-2	+5	0	+3	+3	+2	+2	-7
Duncan on rough lemon:										
Unsprayed.....	20	35	54	62	65	71	78	81	84	86
Sprayed.....	20	39	59	67	69	75	82	84	87	87
Difference.....	0	+4	+5	+5	+4	+4	+4	+3	+3	+1
Duncan on sour orange:										
Unsprayed.....	20	35	55	61	65	73	81	86	87	88
Sprayed.....	20	38	54	68	72	80	85	89	91	91
Difference.....	0	+3	-1	+7	+7	+7	+4	+3	+4	+3

EFFECTS OF LEAD ARSENATE SPRAY

WEIGHT OF FRUIT

The average weight of grapefruit was affected by one application of lead arsenate in the summer prior to harvest. The fruit of both the Marsh and the Duncan variety from the sprayed plots weighed slightly less than that from the unsprayed plots (figs. 16 to 19, table 5). It is also interesting to observe that, as in unsprayed fruit, variety and rootstock affected the average weight per fruit. Duncan fruit had a greater average weight than the Marsh, and both kinds weighed more when on rough lemon rootstock than when on sour orange. (For detailed results see tables 34 to 60, Appendix.)

VOLUME OF JUICE

The volume of juice in the fruit from sprayed Marsh and Duncan trees gradually increased with maturity and ripening as in that from unsprayed trees. Lead arsenate spray did not significantly affect the volume when the data were computed on the basis of milliliters of juice per 100 gm. of fruit (table 6) or as percentage of the fruit that was juice (table 7). A very slightly greater volume of juice resulted when the Marsh fruit were from trees grown on sour orange rootstock than on rough lemon. The results were not conclusive in the case of the Duncan fruit. (See tables 34 to 60, Appendix.)

Marsh fruit from sprayed trees contained a consistently greater volume than did fruit from similarly sprayed Duncan trees, the same as reported earlier for unsprayed fruit.

ASCORBIC ACID

Spraying with lead arsenate in the summer did not lower the ascorbic acid concentration of the juice; in fact, the vitamin concentration in sprayed fruit was very slightly greater, but these results are probably not significant, as may be seen from the data given in table 8 and figures 16 to 19. They are of interest, however, since Nelson and Mottern (24) reported that the vitamin C content of oranges from trees sprayed with lead arsenate was found to be considerably lower than that of oranges from unsprayed trees of the same variety and the same degree of maturity. As with fruit from unsprayed trees, the highest average concentrations of ascorbic acid were found in immature Marsh and Duncan grapefruit. As the fruit ripened the milligrams of ascorbic acid per milliliter of juice gradually decreased, and the lowest values were found late in the season in very ripe fruit.

Rootstock and variety affected the ascorbic acid content of the sprayed fruit in the way already reported for the unsprayed. The grapefruit on sour orange rootstock contained a slightly greater concentration, which was found to be more consistent in the Marsh than in the Duncan. Comparisons between these varieties indicated slightly higher ascorbic acid values in the Duncan than in the Marsh fruit. (See tables 34 to 60, Appendix.)

TOTAL SOLIDS

Tables 9 and 34 to 60, Appendix, indicate that the total solids were generally highest when the sprayed grapefruit was in prime eating condition. Slightly lower solids were usually found earlier in the

season in immature fruit and also late in the season in very ripe fruit. The data indicate that the gradient was more pronounced in Duncan than in Marsh fruit.

Spraying with lead arsenate did not greatly affect the total solids content of the fruit, as shown in summary form in figures 16 to 19 and in table 9. The increases or decreases caused by spraying were also computed (table 9).

The results herein presented are in general agreement with the findings of Miller, Bassett, and Yothers (23), who showed that the total solids of fruit juice were somewhat increased when as little as 0.008 mg. of arsenic trioxide was present on the leaves at the time the fruit reached maturity but that solids decreased when more than this was present.

Rootstock on which the sprayed grapefruit was grown affected the total solids content of the fruit, both the Marsh and the Duncan fruit containing greater amounts when on sour orange rootstock than on rough lemon. Duncan had greater total solids content than did Marsh. This is in agreement with the results reported earlier for fruit from unsprayed trees.

TOTAL ACID

The total acid in sprayed grapefruit decreased regularly with maturity and ripening. The detailed data on total acid content are presented in tables 34 to 60, Appendix, and average values are shown in table 10 and figures 16 to 19.

Spraying with lead arsenate significantly affected the acid content of the fruit, and the reduction in acidity is shown in table 10. Tests made on immature fruit picked about September 1 showed that the lead arsenate spray reduced the acidity about 4 to 9 percent below that in the unsprayed fruit. In the very ripe fruit picked in May the total acid of the sprayed fruit was reduced about 21 to 26 percent. The effect of lead arsenate on the total acid content of the fruit therefore appears to be progressive, the differences becoming greater as the fruit ripens.

These findings are in agreement with those of Miller, Bassett, and Yothers (23), who found that when arsenic was present on the leaves not so much acid was formed in the fruit and what was formed disappeared more rapidly than it did in unsprayed fruit.

It will also be noted from table 10 that the rootstock on which the sprayed trees were grown affected the total acid and that both the Marsh and the Duncan grapefruit on sour orange rootstock contained a higher percentage of total acid than when they were on rough lemon; the Duncan variety had a slightly greater total acid content than did the Marsh.

RATIO OF TOTAL SOLIDS TO TOTAL ACID

Figures 16 to 19 and table 11 show the ratios of total solids to total acid. These data were calculated from the average values obtained for total solids (table 9) and for total acid (table 10).

As with unsprayed fruit, the ratio of solids to acid generally increased with maturity and ripening of the fruit. This increase was primarily due to the consistent decrease in the total acid, since the solids were generally highest when the grapefruit were in prime eating condition and lowest in immature and also in very ripe fruit.

Spraying with lead arsenate hastened the lowering of acidity of the grapefruit and resulted in higher ratios of solids to acid at an earlier date and in an earlier attainment of legal maturity than in unsprayed fruit. According to these data sprayed grapefruit passed the legal ratio requirement from about 1 to about 4 months earlier than the unsprayed fruit. Table 11 indicates that the sprayed fruit passed the legal ratio requirement between September 25 and October 28, whereas the unsprayed fruit passed the legal solids to acid requirement between October 23 and January 20.

In the Marsh variety the fruit from the unsprayed and sprayed trees on sour orange rootstock passed the legal ratio of solids to acid earlier than did comparable fruit on rough lemon rootstock, while in the Duncan variety these differences due to rootstock were not always consistent.

Comparative ratios of total solids to acid as affected by spraying with lead arsenate are shown in tables 34 to 60, Appendix.

PALATABILITY OF FRUIT

The flavor of the sprayed fruit was evaluated according to the method and the arbitrary standard scale described on page 16. The averages presented in figures 16 to 19 and in table 12 are fairly consistent throughout the period of sampling and showed a gradual increase in the eating quality of grapefruit with ripening. The lower acidity caused by spraying with lead arsenate resulted in a more palatable fruit, as shown by the higher numerical ratings as compared with those obtained for fruit not sprayed with lead arsenate. The differences in palatability due to this spray are also brought out in table 12, which shows change in flavor resulting from this treatment.

Immature, unpalatable fruit was rated below 70, while the qualifications for consumer acceptability were ratings of 70 to 100. On this basis Florida grapefruit met consumer approval by about January 15, with most of the fruit approaching this standard about a month earlier. From January into May the degree of palatability gradually increased. The slightly higher numerical values shown for the sprayed fruit indicated an earlier consumer approval and a general preference for it as compared with the control, or unsprayed, fruit. (See tables 34 to 60, Appendix.)

The data obtained on palatability do not support present legal maturity ratio standards very closely. The data on internal quality shown in table 12 indicate that the present ratio requirement permits the shipment of sour fruit regarded by the taste judges as below the standard of acceptability.

The findings show that rootstock influenced the flavor of the sprayed fruit. It may be noted that both Marsh and Duncan fruit had higher numerical taste ratings when they were grown on sour orange rootstock than on rough lemon. Variety also influenced the flavor slightly, Duncan usually being rated higher than Marsh. The small differences in the averages are statistically significant.

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APPENDIX

TABLE 13.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Davenport, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}			Flesh color ^{2,4}			Flesh texture ^{2,5}				Diameter of fruit ²				Rind thickness ²					
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43
	<i>Gm.</i>	A	B	C	A	GY	GY	GY	Ricey	Ricey	Ricey	Ricey	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	
Aug. 25-Sept. 2.....	295	D	B	B	B	GY	GY	GY	Coarse	Coarse	Coarse	Coarse	95	91	92	10	10	8	8	8	
Sept. 25-30.....	355	D	B	D	D	PY	PY	PY	do	do	do	do	98	94	101	10	10	6	7	7	
Oct. 23-28.....	417	E	D	D	D	PY	PY	PY	do	do	do	do	102	100	105	8	6	6	7	7	
Nov. 20-25.....	485	F	E	E	E	PY	TY	TY	Good	Good	Coarse	Coarse	112	106	111	9	7	8	7	7	
Dec. 18-23.....	525	G	E	E	F	PY	TY	TY	do	do	do	do	113	107	117	9	7	7	8	8	
Jan. 15-20.....	553	G	F	F	F	TY	TY	TY	do	do	do	do	116	111	118	11	7	7	8	8	
Feb. 12-17.....	588	G	F	F	G	TY	TY	TY	F (40)	do	do	do	116	110	121	11	6	8	8	8	
Mar. 11-16.....	588	G	F	F	G	TY	TY	TY	F (60)	do	do	do	116	117	122	11	8	8	8	8	
Apr. 8-13.....	609	F	F	F	G	TY	TY	TY	F (56)	do	do	do	116	116	124	11	7	8	8	8	
May 6-11.....	628	F	F	F	G	TY	TY	TY	F (68)	do	do	do	118	117	127	11	8	8	8	8	

Picking period	Juice per 100 grams of fruit ⁶	Flavor ²			Total ash ⁷			Ascorbic acid per milliliter ⁷			Active acidity ⁷		
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43
<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Ml.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Mg.</i>	<i>Mg.</i>	<i>Mg.</i>	<i>pH</i>	<i>pH</i>	<i>pH</i>	
Aug. 25-Sept. 2.....	33	V acid	V acid	V acid	V acid	0.276	0.280	0.303	0.46	0.47	0.50	3.13	3.20
Sept. 25-30.....	41	Acid	Acid	Acid	do	0.238	0.254	0.270	47	44	45	3.12	3.10
Oct. 23-28.....	45	Tart	Tart	Tart	Acid	0.238	0.254	0.270	44	41	41	3.05	3.11
Nov. 20-25.....	46	P tart, W	P tart	P tart	Tart	0.195	0.190	0.182	36	44	41	3.15	3.04
Dec. 18-23.....	47	do	do	do	do	0.205	0.195	0.204	36	44	40	3.12	3.17
Jan. 15-20.....	46	do	do	do	P tart	0.205	0.195	0.204	30	39	39	3.15	3.19
Feb. 12-17.....	49	do	do	do	do	0.205	0.195	0.204	38	38	38	3.18	3.27
Mar. 11-16.....	47	do	do	do	P tart	0.205	0.195	0.204	37	39	37	3.19	3.28
Apr. 8-13.....	48	do	do	do	P tart, W	0.205	0.195	0.204	35	32	35	3.26	3.30
May 6-11.....	49	do	do	do	do	0.205	0.195	0.204	35	35	35	3.46	3.38

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁵ Each figure represents a mean of duplicate determinations.⁶ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.⁷ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.

TABLE 13.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Davenport, Fla., 1939-43—Continued

Picking period	Total solids ²				Total acid ²				Solids-acid ratio				Fruit below solids-acid ratio			
	1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42		1942-43	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Aug. 25-Sept. 2.....	7.71±0.04	8.23±0.03	8.56±0.06	8.92	1.49±0.02	1.69±0.02	1.88	5.21	5.52	5.07	4.74	100	100	100	100	100
Sept. 25-30.....	7.71±0.07	8.32±0.05	8.41±0.08	8.98	1.38±0.02	1.46±0.02	1.50	5.84	6.03	5.76	5.99	96	96	96	96	96
Oct. 23-28.....	7.94±0.05	8.63±0.05	8.68±0.08	9.22	1.33±0.01	1.30±0.02	1.55	6.56	6.49	6.68	5.95	64	88	88	76	76
Nov. 20-25.....	7.90±0.05	8.86±0.06	9.00±0.07	9.78	1.32±0.01	1.25±0.01	1.54	7.18	6.71	7.20	6.35	32	72	72	32	32
Dec. 18-23.....	8.56±0.07	8.77±0.07	8.76±0.07	9.59	1.24±0.01	1.22±0.01	1.47	7.58	7.07	7.18	6.52	8	52	52	36	36
Jan. 15-20.....	7.83±0.05	8.77±0.07	8.69±0.07	9.37	1.12±0.02	1.18±0.02	1.44	6.99	7.13	7.36	6.51	40	28	28	24	24
Feb. 12-17.....	7.82±0.07	8.69±0.08	8.60±0.07	9.27	1.03±0.01	1.13±0.02	1.38	7.69	7.69	7.41	6.72	12	12	12	24	24
Mar. 11-16.....	7.73±0.09	8.28±0.07	8.47±0.07	9.30	1.01±0.02	1.07±0.01	1.31	8.25	7.52	7.92	7.10	8	8	8	0	0
Apr. 8-13.....	7.37±0.06	8.37±0.07	8.59±0.07	9.27	.89±0.02	1.02±0.04	1.25	8.28	8.22	8.03	7.42	4	0	0	0	0
May 6-11.....	7.17±0.09	8.15±0.10	8.34±0.11	8.75	.78±0.02	1.01±0.02	1.12	9.19	8.07	9.37	7.81	32	0	0	0	0

² Each figure or description represents a mean of 25 determinations for 1 season.

TABLE 14.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Lake Hamilton, Fla., 1940-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}			Flesh color ^{2,4}		Flesh texture ²			Diameter of fruit ²		Rind thick- ness ²		Juice per 100 grams of fruit ⁵	Flavor ^{2,4}		
		1940- 41	1941- 42	1942- 43	1940- 41	1941- 42	1942-43	1940-41	1941-42	1940-41	1941-42	1940-41	1941-42				
Aug. 25-Sept. 2.....	265	B	B	B	GY	Ricey	Ricey	96	98	7	8	30	37	V acid.	V acid.		
Sept. 25-30.....	354	C	C	C	GY	Coarse	Coarse	98	101	7	8	43	43	Acid.	Acid.		
Oct. 23-28.....	385	E	D	D	GY	Good	Good	104	107	8	8	42	42	Tart.	Tart.		
Nov. 20-25.....	433	F	E	E	TY	do	do	107	116	8	9	44	44	do	do		
Dec. 18-23.....	497	F	F	F	TY	Good	do	110	116	8	9	44	44	P tart.	P tart.		
Jan. 15-20.....	527	G	F	G	TY	do	do	115	118	8	8	45	45	do	do		
Feb. 12-17.....	561	G	F	G	TY	do	do	116	119	8	8	46	46	do	do		
Mar. 11-16.....	603	G	F	G	TY	do	do	119	125	9	9	46	46	P tart to S.	P tart to S.		
Apr. 8-13.....	660	G	F	G	TY	do	do	122	125	9	8	46	46	do	do		
May 6-11.....	689	G	F	G	TY	do	do							do	do		

¹ Each figure represents a mean of 50 or 75 determinations for 1940-41, 1941-42 and 1942-43.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly;

S, sweet; W, watery.

⁵ Each figure represents a mean of 50 or 75 determinations for 3 seasons; juice extracted by means of an electric reamer.

TABLE 15.—Seasonal changes in physical characters and chemical constituents of *Marsh grapefruit on rough lemon rootstock at Windermere, Fla., 1939-41*

Picking period	Total ash ¹		Ascorbic acid per milliliter ²		Active acidity ³		Total solids ⁴		Total acid ⁵		Solids-acid ratio		Fruit below solids-acid ratio
	1940-41	1941-42	1940-41	1942-43	1940-41	1941-42	1940-41	1941-42	1940-41	1942-43	1940-41	1942-43	
	Pct.	Pct.	Mg.	Mg.	pH	pH	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Aug. 25-Sept. 2	0.384	0.384	0.53	0.48	3.11	3.01	9.17±0.05	9.51±0.08	1.70±0.02	1.97±0.02	5.39	5.57	Pct. 100
Sept. 25-30	0.329	0.258	0.46	0.44	3.10	3.09	9.25±0.09	9.07±0.04	1.73±0.03	1.61±0.01	5.63	6.24	100
Oct. 23-28	0.329	0.258	0.43	0.46	3.05	3.06	9.52±0.05	9.25±0.05	1.47±0.01	1.55	5.50	6.13	100
Nov. 20-25	0.324	0.206	0.44	0.43	3.10	3.05	10.35±0.10	9.57±0.11	1.66±0.04	1.34±0.01	6.23	6.76	68
Dec. 18-23	0.347	0.188	0.45	0.37	3.10	2.96	11.37±0.10	9.13±0.05	1.73±0.04	1.45	6.57	7.28	40
Jan. 15-20	0.347	0.188	0.40	0.35	3.03	3.03	10.68±0.22	9.23±0.07	1.55±0.05	1.25±0.02	6.89	7.03	36
Feb. 12-17	0.296	0.216	0.37	0.34	3.09	3.18	11.06±0.11	9.28±0.05	1.54±0.03	1.35	7.03	7.35	16
Mar. 11-16	0.296	0.216	0.37	0.34	3.13	3.13	11.06±0.11	9.28±0.05	1.54±0.03	1.35	7.03	7.35	16
Apr. 8-13	0.296	0.216	0.36	0.33	3.18	3.18	10.82±0.10	9.86±0.09	1.43±0.04	1.07±0.01	7.14	8.13	8
May 6-11	0.32	0.32	0.32	0.34	3.37	3.26	10.45±0.14	8.95±0.11	1.28±0.05	1.00±0.01	8.19	9.24	0

¹ Each figure or description represents a mean of 25 determinations for 1 season.² Each figure represents a mean of duplicate determinations.³ Each figure represents a mean of duplicate determinations.⁴ Each figure represents a mean of duplicate determinations.⁵ Each figure represents a mean of duplicate determinations.⁶ Each figure represents a mean of duplicate determinations.¹ Each figure represents a mean of 50 determinations for 1939-40 and 1940-41.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasant; S, sweet; W, watery.⁵ F, freezing damage. The number in parentheses after F represents the percentage of fruit in sample showing freezing damage.⁶ Each figure represents a mean of 25 determinations for 1 season; juice extracted by means of an electric reamer.

Picking period	Weight per fruit ¹	Rind color ^{2,3}		Flesh color ^{2,4}		Flesh texture ^{2,5}		Diameter of fruit ¹		Rind thickness ²		Juice per 100 grams of fruit ⁶		Flavor ^{2,4}	
		1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41
		Gm.						Mm.	Mm.	Mm.	Mm.	Ml.			
Aug. 25-Sept. 2	313	C	C	GY	PY	Ricey	Ricey	93	92	9	7	36	V acid	Acid.	
Sept. 25-30	364	D	D	PY	PY	Coarse	Coarse	96	97	6	8	45	Acid.	Do.	
Oct. 23-28	430	E	E	PY	PY	Good	Good	105	101	6	6	49	Tart.	Tart.	
Nov. 20-25	482	F	F	PY	PY	do	do	107	105	9	7	52	P tart, W.	Do.	
Dec. 18-23	494	F	F	PY	PY	do	Good	110	106	8	7	50	do	Do.	
Jan. 15-20	542	F	F	TY	TY	do	do	114	110	8	7	49	do	Do.	
Feb. 12-17	557	G	G	TY	TY	F (12)	do	116	109	8	6	50	do	Do.	
Mar. 11-16	533	F	G	TY	TY	F (12)	do	113	106	8	6	50	do	Do.	
Apr. 8-13	553	F	G	TY	TY	F (32)	do	116	111	8	8	48	do	Do.	
May 6-11	566	G	G	TY	TY	F (32)	do	117	110	9	8	47	do	Do.	

TABLE 15.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Wandermere, Fla., 1939-41—Continued

Picking period	Total ash ⁷		Ascorbic acid per milliliter ⁷		Active acidity ⁷		Total solids ²		Total acid ²		Solids-acid ratio		Fruit below solids-acid ratio	
	1939-40		1939-40		1939-40		1939-40		1939-40		1939-40		1939-40	
	Pct.	Pct.	Mg.	Mg.	pH	pH	Pct.	Pct.	Pct.	Pct.			Pct.	Pct.
Aug. 25-Sept. 2	0.288	0.218	0.46	0.49	3.07	3.17	7.69±0.06	8.16±0.03	1.53±0.01	1.56±0.02	4.99	5.23	100	100
Sept. 25-30			0.43	0.48	3.05	3.10	7.88±0.07	8.44±0.03	1.33±0.01	1.36±0.02	5.97	5.78	96	100
Oct. 23-28	.265	.242	.39	.47	3.10	3.10	8.04±0.07	8.72±0.03	1.13±0.02	1.38±0.03	7.12	6.32	52	80
Nov. 20-25			.37	.45	3.07	3.08	7.69±0.07	8.81±0.06	1.13±0.01	1.41±0.02	6.09	6.25	72	96
Dec. 18-23	.232	.227	.39	.45	3.07	3.09	7.82±0.05	8.77±0.03	1.13±0.01	1.36±0.02	6.08	6.45	84	96
Jan. 15-20			.32	.43	3.20	3.16	8.02±0.06	8.44±0.07	1.24±0.03	1.27±0.02	6.95	6.65	48	80
Feb. 12-17	.210	.183	.34	.40	3.17	3.19	8.48±0.09	8.09±0.07	1.22±0.03	1.21±0.02	6.95	6.69	44	72
Mar. 11-16			.31	.41	3.20	3.23	8.05±0.11	8.31±0.08	1.30±0.03	1.21±0.02	7.15	7.04	32	52
Apr. 8-13	.210	.214	.33	.40	3.21	3.21	8.71±0.11	8.07±0.13	1.30±0.03	1.17±0.03	6.70	7.41	68	28
May 6-11			.29	.42	3.32	3.27	7.91±0.12	8.51±0.14	1.01±0.03	1.14±0.02	7.83	7.46	24	20

² Each figure or description represents a mean of 25 determinations for 1 season.⁷ Each figure represents a mean of duplicate determinations.

TABLE 16.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Bradenton, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}			Flesh color ^{2,4}			Flesh texture ²			Diameter of fruit ²			Rind thickness ²		
		1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42
		Gm.			Gm.						Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
Aug. 25-Sept. 2	280	C	C	C	GY	GY	GY	Ricey	Ricey	Ricey	98	81	82	8	7	7
Sept. 25-30	316	D	D	D	GY	GY	GY	Coarse	Coarse	Coarse	99	80	84	6	6	6
Oct. 23-28	390	E	E	E	TY	TY	TY	Good	Good	Good	105	98	97	6	5	5
Nov. 20-25	453	F	F	F	TY	TY	TY	do.	do.	do.	110	101	102	6	6	6
Dec. 18-23	530	F	F	F	TY	TY	TY	do.	do.	do.	111	109	112	6	6	6
Jan. 15-20	533	F	F	F	TY	TY	TY	do.	do.	do.	115	104	116	8	5	5
Feb. 12-17	538	F	F	F	TY	TY	TY	do.	do.	do.	114	104	113	7	5	5
Mar. 11-16	571	F	F	F	TY	TY	TY	do.	do.	do.	120	109	116	8	6	6
Apr. 8-13	568	F	F	F	TY	TY	TY	do.	do.	do.	112	111	120	8	6	6
May 6-11	602	G	H	F	TY	TY	TY	do.	do.	do.	119	110	121	8	6	7

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.² See U. S. Department of Agriculture color chart (pl. 4).³ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasant; S, sweet; W, watery.⁴ Each figure or description represents a mean of 25 determinations for 1 season.

Picking period	Juice per 100 grams of fruit ⁵	Flavor ² 4			Total ash ⁶			Ascorbic acid per milliliter ⁶			Active acidity ⁶				
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1942-43
	<i>Ml.</i>	V acid.	V acid	V acid.	V acid.	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Mg.</i>	<i>Mg.</i>	<i>Mg.</i>	<i>pH</i>	<i>pH</i>	<i>pH</i>	<i>pH</i>
Aug. 25-Sept. 2	34	Acid	Acid	Acid	do.	0.394	0.285	0.286	0.47	0.46	0.55	3.09	3.19	3.08	3.04
Sept. 25-30	44	Tart.	Tart.	Tart.	do.	.264	.302	.283	.41	.47	.48	3.03	3.22	3.03	3.00
Oct. 23-28	48	P tart.	do.	P tart.	do.	.184	.214	.197	.39	.44	.41	3.08	3.06	3.04	3.00
Nov. 20-25	50	P tart.	do.	do.	P tart.	.198	.200	.217	.41	.44	.37	3.10	3.08	3.07	2.97
Dec. 18-23	53	do.	do.	do.	P tart.	.198	.200	.217	.38	.42	.35	3.05	3.14	3.16	2.98
Jan. 15-20	52	do.	do.	do.	P tart. to S	.238	.207	.206	.39	.39	.35	3.10	3.16	3.13	3.04
Feb. 12-17	53	do.	do.	do.	P tart to S				.36	.36	.34	3.22	3.22	3.19	3.10
Mar. 11-16	53	do.	do.	P tart to S	do.				.32	.38	.34	3.31	3.30	3.29	3.10
Apr. 8-13	53	P tart, W	do.	P tart to S,	do.				.37	.37	.32	3.31	3.30	3.31	3.22
May 6-11	54		do.	W.	do.										

Picking period	Total solids ²			Total acid ²			Solids-acid ratio			Fruit below solids-acid ratio		
	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43
	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>
Aug. 25-Sept. 2	7.67±0.07	9.28±0.10	9.28±0.06	8.87	1.60±0.01	1.70±0.02	1.81±0.01	1.85	4.79	4.93	5.13	4.79
Sept. 25-30	8.09±0.04	8.38±0.05	9.29±0.08	9.02	1.33±0.01	1.52±0.02	1.54±0.01	1.41	6.08	5.39	6.03	6.40
Oct. 23-28	8.18±0.06	8.89±0.05	9.05±0.04	9.42	1.17±0.01	1.51±0.02	1.27±0.01	1.47	6.99	5.85	7.13	6.41
Nov. 20-25	8.06±0.05	8.80±0.08	9.03±0.06	9.18	1.09±0.01	1.40±0.02	1.23±0.01	1.29	7.39	6.29	7.34	7.12
Dec. 18-23	8.32±0.07	9.23±0.13	9.15±0.11	9.29	1.08±0.02	1.42±0.01	1.17±0.02	1.28	7.70	6.50	7.82	7.26
Jan. 15-20	8.01±0.06	8.49±0.07	9.17±0.09	9.03	1.06±0.01	1.28±0.02	1.08±0.02	1.23	7.56	6.63	8.49	7.34
Feb. 12-17	7.87±0.06	8.94±0.10	9.14±0.07	9.23	1.07±0.01	1.29±0.03	1.07±0.01	1.17	7.36	6.97	8.54	7.89
Mar. 11-16	7.60±0.06	8.78±0.06	9.23±0.07	9.01	1.03±0.01	1.22±0.02	1.01±0.01	1.15	7.38	7.20	9.15	7.83
Apr. 8-13	7.18±0.09	8.23±0.19	8.63±0.04	8.13	1.01±0.01	1.12±0.02	.85±0.02	1.09	7.11	8.24	10.15	8.38
May 6-11	7.53±0.12	8.70±0.12	8.40±0.06	8.37	.91±0.02	1.07±0.02	.82±0.02	.97	8.27	8.13	10.24	8.63

² Each figure or description represents a mean of 25 determinations for 1 season.⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly;

S, sweet; W, watery.

⁵ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.⁶ Each figure represents a mean of duplicate determinations.

TABLE 17.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Fort Pierce, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}				Flesh color ^{2,4}				Flesh texture ^{2,5}				Diameter of fruit ²				Rind thickness ²							
		1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42		1942-43	
		Gm.	C	D	E	C	B	GY	GY	Ricey	Coarse	Good	Good	Ricey	Coarse	Good	Good	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
Aug. 25-Sept. 2	281	C	D	E	F	C	B	GY	GY	Ricey	Coarse	Good	Good	Ricey	Coarse	Good	Good	96	96	85	85	7	7	6	6
Sept. 25-30	346	D	E	F	F	D	C	PY	PY	Coarse	Coarse	Good	Coarse	do	do	Coarse	Coarse	96	96	91	91	7	7	6	6
Oct. 23-28	416	E	E	E	F	E	D	PY	PY	do	do	do	Coarse	do	do	do	do	103	106	101	101	7	6	6	6
Nov. 20-25	500	E	E	E	F	E	D	PY	PY	do	do	do	Coarse	do	do	do	do	103	106	101	101	7	6	6	6
Dec. 18-23	524	F	F	F	F	F	E	PY	PY	do	do	do	Good	do	do	Good	Good	112	109	108	108	7	6	6	6
Jan. 15-20	575	F	F	F	F	F	E	PY	PY	do	do	do	Good	do	do	Good	Good	112	111	112	112	7	6	6	6
Feb. 12-17	594	F	F	F	F	F	E	PY	PY	do	do	do	do	do	do	do	do	116	114	116	116	8	6	6	5
Mar. 11-16	609	F	F	F	F	F	E	PY	PY	do	do	do	do	do	do	do	do	117	120	116	116	8	7	5	5
Apr. 8-13	627	F	F	F	F	F	E	PY	PY	do	do	do	do	do	do	do	do	116	122	119	119	8	7	6	7
May 6-11	629	F	F	F	F	F	E	PY	PY	do	do	do	do	do	do	do	do	115	123	119	119	8	7	7	7

Picking period	Juice per 100 grams of fruit ⁶	Flavor ^{2,4}				Total ash ⁷				Ascorbic acid per milliliter ⁷				Active acidity ⁷									
		1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42		1939-40		1940-41		1941-42		1942-43	
		V acid	V acid	V acid	V acid	V acid	V acid	V acid	V acid	Pct.	Pct.	Pct.	Pct.	Mg.	Mg.	Mg.	Mg.	pH	pH	pH	pH	pH	pH
Aug. 25-Sept. 2	31	Acid	Acid	Acid	Acid	Acid	Acid	Acid	Acid	0.336	0.335	0.330	0.41	0.47	0.48	0.56	0.45	0.56	3.13	3.10	3.10	3.08	
Sept. 25-30	39	do	do	do	do	do	do	do	do	.223	.264	.287	.36	.42	.44	.45	.44	.44	3.08	3.12	3.12	2.97	
Oct. 23-28	46	Tart.	Tart.	Tart.	Tart.	Tart.	Tart.	Tart.	Tart.	.223	.264	.287	.36	.42	.44	.45	.44	.44	3.07	3.13	3.13	2.97	
Nov. 20-25	49	do	do	do	do	do	do	do	do	.197	.222	.189	.34	.39	.42	.39	.34	.39	3.10	3.17	3.17	2.95	
Dec. 18-23	51	P tart.	P tart.	P tart.	P tart.	P tart.	P tart.	P tart.	P tart.	.208	.230	.156	.31	.36	.37	.37	.37	.37	3.12	3.16	3.16	2.95	
Jan. 15-20	50	do	do	do	do	do	do	do	do	.208	.230	.156	.31	.36	.37	.37	.37	.37	3.20	3.12	3.12	3.02	
Feb. 12-17	51	do	do	do	do	do	do	do	do	.214	.221	.220	.30	.33	.36	.36	.36	.36	3.23	3.13	3.13	3.02	
Mar. 11-16	52	do	do	do	do	do	do	do	do	.214	.221	.220	.31	.35	.36	.36	.36	.36	3.20	3.21	3.17	3.08	
Apr. 8-13	51	do	do	do	do	do	do	do	do	.214	.221	.220	.31	.35	.36	.36	.36	.36	3.27	3.21	3.21	3.08	
May 6-11	52	do	do	do	do	do	do	do	do	.214	.221	.220	.32	.31	.35	.32	.32	.32	3.40	3.29	3.29	3.07	

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.

² Each figure or description represents a mean of 25 determinations for 1 season.

³ See U. S. Department of Agriculture color chart (pl. 4).

⁴ GY, greenish yellow; PY, pale yellow; F Y, fawnish yellow; V, very; P, pleasantly;

S, sweet; W, watery.

⁵ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.

⁶ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.

⁷ Each figure represents a mean of duplicate determinations.

Picking period	Total solids ²				Total acid ²				Solids-acid ratio				Fruit below solids-acid ratio	
	1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Aug. 25-Sept. 2.....	7.12±0.05	8.20±0.09	7.90±0.08	9.28	1.38±0.02	1.74±0.02	1.78±0.02	1.77	5.12	4.71	4.44	5.24	100	Pct.
Sept. 25-30.....	7.34±0.07	8.17±0.06	8.38±0.04	8.63	1.21±0.01	1.57±0.02	1.53±0.02	1.51	6.07	5.20	6.00	5.72	100	100
Oct. 23-28.....	7.03±0.06	8.04±0.06	8.88±0.04	8.82	1.09±0.01	1.33±0.02	1.20±0.02	1.14	6.45	5.84	7.05	5.92	96	96
Nov. 20-25.....	7.07±0.06	8.51±0.05	8.80±0.03	8.87	1.03±0.01	1.43±0.02	1.14±0.01	1.39	6.77	6.30	7.79	6.38	94	8
Dec. 18-23.....	7.90±0.05	8.51±0.05	8.80±0.03	8.82	1.04±0.02	1.41±0.02	1.09±0.01	1.30	6.73	6.74	8.07	6.86	84	0
Jan. 15-20.....	7.97±0.06	8.45±0.06	8.80±0.06	8.83	.87±0.02	1.32±0.02	.93±0.01	1.24	7.56	7.16	9.58	6.79	76	0
Feb. 12-17.....	7.18±0.08	8.46±0.08	8.63±0.11	8.80	.86±0.02	1.32±0.02	.96±0.01	1.22	7.49	7.32	9.58	7.30	36	0
Mar. 11-16.....	7.04±0.05	8.48±0.08	8.90±0.11	8.90	.94±0.02	1.24±0.02	.90±0.01	1.22	8.12	7.65	9.58	7.30	52	0
Apr. 8-13.....	6.74±0.07	8.55±0.06	8.93±0.11	9.17	.83±0.02	1.17±0.02	.86±0.02	1.18	8.12	8.16	10.41	7.77	76	0
May 6-11.....	6.77±0.10	9.45±0.14	9.22±0.10	9.10	.80±0.01	1.09±0.02	.83±0.01	1.07	8.46	8.70	11.11	8.50	72	0

² Each figure or description represents a mean of 25 determinations for 1 season.

TABLE 18.—Seasonal changes in physical characters and chemical constituents of *Marsh grapefruit* on rough lemon rootstock at Homestead, Fla., grove 1, 1939-42

Picking period	Weight per fruit ¹	Rind color ^{2,3}		Flesh color ^{2,4}		Flesh texture ²		Diameter of fruit ²		Rind thickness ²		Juice per 100 grams of fruit ²		Flavor ^{2,4}	
		1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41
		40	41	40	41	40	41	40	41	40	41	40	41	1939-40	1940-41
Aug. 25-Sept. 2.....	Gm.	C	C	GY	GY	Riccy.	Riccy.	Mm.	Mm.	Mm.	Mm.	Ml.	Ml.	Tart.	Acid
Sept. 25-30.....	308	D	D	GY	PY	Coarse	Coarse	44	88	7	7	38	48	do.	F tart, W.
Oct. 23-28.....	345	D	D	PY	PY	Coarse	Coarse	66	95	6	6	6	6	do.	Do.
Nov. 20-25.....	408	E	D	PY	TY	Good	Good	100	100	6	6	7	51	do.	Do.
Dec. 18-23.....	474	F	D	PY	TY	Good	Good	107	107	6	6	6	51	do.	Do.
Jan. 15-20.....	533	F	D	TY	TY	Good	Good	107	107	6	6	6	52	do.	Do.
Feb. 12-17.....	522	F	E	TY	TY	Good	Good	106	110	6	6	6	52	do.	Do.
Mar. 11-16.....	513	F	F	TY	TY	Good	Good	105	109	6	6	6	51	do.	Do.
Apr. 8-13.....	588	F	F	TY	TY	Good	Good	109	111	6	6	6	47	do.	Do.
May 6-11.....	602	F	F	TY	TY	Good	Good	111	116	7	7	48	49	P tart, W	do.

¹ Each figure represents a mean of 50 or 75 determinations for 1939-40, 1940-41, and 1941-42.

² Each figure or description represents a mean of 25 determinations for 1 season.

³ See U. S. Department of Agriculture color chart (pl. 4).

⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.

Each figure represents a mean of 50 or 75 determinations for 3 seasons; juice extracted by means of an electric reamer.

TABLE 18.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Homestead, Fla., grove 1, 1939-42—Continued

Picking period	Total ash ^a		Ascorbic acid per milliliter ^a		Active acidity ^a		Total solids ²			Total acid ²			Solids-acid ratio			Fruit below solids-acid ratio	
	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41
	Pct.	Pct.	Mg.	pH	pH	pH	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Aug. 25-Sept. 2	0.234	0.216	0.41	3.04	3.17	3.04	9.09±0.06	8.09±0.06	9.18±0.07	1.58±0.02	1.55±0.03	1.57±0.02	5.75	5.19	5.85	100	100
Sept. 25-30	0.234	0.216	0.41	3.04	3.17	3.04	8.35±0.11	7.81±0.09	8.86±0.08	1.30±0.02	1.35±0.02	1.35±0.02	6.42	5.79	7.38	84	96
Oct. 23-28	0.243	0.269	0.40	3.08	3.16	3.08	8.74±0.06	8.20±0.06	9.07±0.07	1.13±0.02	1.36±0.04	1.20±0.02	7.73	6.03	7.38	84	96
Nov. 20-25	0.243	0.269	0.40	3.08	3.16	3.08	8.94±0.07	8.29±0.08	9.07±0.07	1.07±0.01	1.21±0.04	1.22±0.02	8.36	6.85	7.43	0	50
Dec. 18-23	0.212	0.225	0.40	3.16	3.22	3.16	8.66±0.08	8.19±0.08	9.01±0.08	1.03±0.01	1.20±0.02	1.16±0.02	8.41	6.83	7.77	0	50
Jan. 15-20	0.176	0.200	0.41	3.13	3.21	3.28	9.15±0.09	7.92±0.10	9.08±0.09	1.05±0.01	1.16±0.02	1.05±0.03	8.71	6.83	8.65	0	72
Feb. 12-17	0.176	0.200	0.41	3.15	3.27	3.30	9.10±0.12	8.25±0.10	9.08±0.09	1.02±0.02	1.09±0.02	1.05±0.03	8.92	7.57	8.65	0	20
Mar. 11-16	0.176	0.200	0.41	3.15	3.27	3.30	8.37±0.19	8.21±0.19	9.08±0.09	1.12±0.03	1.12±0.03	1.05±0.03	7.47	7.89	8.65	0	20
Apr. 8-13	0.241	0.241	0.37	3.34	3.40	3.47	8.21±0.19	8.21±0.19	9.08±0.09	1.04±0.02	1.04±0.02	1.05±0.03	7.89	7.89	8.65	12	12
May 6-11	0.241	0.241	0.35	3.47	3.47	3.47	7.78±0.17	7.78±0.17	9.08±0.09	0.94±0.02	0.94±0.02	1.05±0.03	8.28	8.28	8.65	4	4

² Each figure or description represents a mean of 25 determinations for 1 season.³ Each figure represents a mean of duplicate determinations.

TABLE 19.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Homestead, Fla., grove 2, 1941-42

Picking period	Weight per fruit ¹	Rind color ¹²	Flesh color ¹³	Flesh texture ¹	Diameter of fruit ¹	Rind thickness ¹	Juice per 100 grams of fruit ⁴	Flavor ¹³	Total ash ⁵	Ascorbic acid per milliliter ⁵	Active acidity ⁵	Total solids ¹	Total acid ¹	Solids-acid ratio	Fruit below solids-acid ratio
	Gm.	C	GY	Ricey	Mm.	Mm.	Ml.	V acid Tart.	Pct.	Mg.	pH	Pct.	Pct.	Pct.	Percent
Aug. 25-Sept. 2	237	C	GY	do	84	7	34	do	0.286	0.61	3.14	9.68±0.14	1.75±0.03	5.53	100
Sept. 25-30	331	C	PY	do	95	7	38	do	0.252	0.54	3.15	10.38±0.04	1.49±0.03	6.97	24
Oct. 23-28	385	D	PY	do	97	6	44	P tart.	0.197	0.45	3.10	9.87±0.05	1.29±0.02	7.65	4
Nov. 20-25	472	E	PY	Coarse	105	6	46	do	0.170	0.45	3.06	10.01±0.07	1.26±0.01	7.94	0
Dec. 18-23	575	F	PY	Good	112	6	51	do	0.170	0.42	3.10	9.95±0.05	1.22±0.02	8.16	0
Jan. 15-20	605	F	TY	do	113	6	48	do	0.170	0.42	3.19	10.28±0.08	1.11±0.02	9.26	0
Feb. 12-17	600	F	TY	do	113	5	51	do	0.215	0.42	3.19	10.42±0.08	1.11±0.02	9.39	0
Mar. 11-16	634	F	TY	do	115	6	50	do	0.215	0.42	3.20	10.72±0.11	1.09±0.02	9.83	0
Apr. 8-13	690	F	TY	do	119	6	50	P tart.	0.37	0.40	3.23	10.40±0.10	1.00±0.02	10.40	0
May 6-11	713	F	TY	do	120	7	53	W (overripe)	0.37	0.37	3.32	10.32±0.14	0.96±0.02	10.75	0

¹ Each figure or description represents a mean of 25 determinations for 1 season.⁴ Each figure or description represents a mean of 25 determinations for 1 season; juice extracted by means of an electric reamer.⁵ Each figure represents a mean of duplicate determinations.¹² See U. S. Department of Agriculture color chart (pl. 4).¹³ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.

TABLE 20.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock at Davenport, Fla., 1939-42

Picking period	Weight per fruit ¹	Rind color ^{2,3}		Flesh color ^{2,4}		Flesh texture ²		Diameter of fruit ²		Rind thickness ²		Juice per 100 grams of fruit ⁵		Flavor ²	
		1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1941-42	1939-40	1941-42	1939-40	1941-42	1939-40	1941-42
		Gm.						Mm.		Mm.		Ml.			
Aug. 25-Sept. 2	304	B	C	GY	PY	Ricey	Ricey	94	92	93	10	8	6	V acid.	V acid.
Sept. 25-30	326	D	E	TY	TY	Coarse	Coarse	92	90	96	8	31	33	Acid.	Acid.
Oct. 23-28	483	E	F	FY	FY	Good	Good	102	99	103	8	7	6	Tart.	Tart.
Nov. 20-25	485	F	G	TY	TY	do	do	106	104	114	7	7	6	do	do
Dec. 18-23	544	F	F	TY	TY	do	Good	109	111	113	8	7	46	do	do
Jan. 15-20	545	F	F	TY	TY	do	do	111	111	116	8	7	48	P tart.	P tart.
Feb. 12-17	578	F	F	TY	TY	do	do	114	114	117	7	7	47	do	do
Mar. 11-16	616	F	F	TY	TY	do	do	116	120	120	8	7	48	P tart to S.	P tart to S.
Apr. 8-13	673	F	F	TY	TY	do	do	121	121	121	8	8	47	do	do
May 6-11	674	H	H	TY	TY	do	do	120	123	123	8	8	49	do	do

Picking period	Total ash ⁶		Ascorbic acid per milliliter ⁶		Active acidity ⁶		Total solids ²		Total acid ²		Solids-acid ratio		Fruit below solids-acid ratio	
	1939-40	1941-42	1939-40	1941-42	1939-40	1941-42	1939-40	1941-42	1939-40	1941-42	1939-40	1941-42	1939-40	1941-42
	Per cent	Per cent	Mg.	Mg.	pH	pH	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Aug. 25-Sept. 2	0.312	0.253	0.368	0.48	3.13	3.22	9.63±0.07	9.10±0.11	1.74±0.03	1.73±0.02	5.16	5.53	5.26	100
Sept. 25-30	.317	.288	.309	.42	3.14	3.10	9.25±0.13	8.97±0.15	1.62±0.03	1.57±0.02	6.34	5.71	5.71	100
Oct. 23-28	.317	.288	.309	.46	3.17	3.15	9.03±0.05	9.44±0.15	1.37±0.01	1.41±0.01	7.59	6.31	6.70	84
Nov. 20-25	.304	.257	.222	.38	3.20	3.24	9.07±0.07	10.61±0.10	1.50±0.03	1.38±0.01	7.62	7.07	7.34	12
Dec. 18-23	.304	.257	.222	.42	3.20	3.13	9.89±0.07	10.65±0.15	1.19±0.02	1.34±0.01	8.24	7.01	7.37	8
Jan. 15-20	.304	.257	.222	.38	3.20	3.13	9.89±0.07	10.65±0.15	1.20±0.02	1.29±0.02	8.24	7.01	7.37	0
Feb. 12-17	.228	.220	.220	.36	3.26	3.18	9.70±0.10	10.46±0.07	1.50±0.02	1.26±0.02	7.03	8.11	8.11	0
Mar. 11-16	.218	.247	.247	.34	3.34	3.30	9.06±0.22	10.43±0.18	1.41±0.02	1.26±0.02	6.94	8.47	8.47	0
Apr. 8-13	.218	.247	.247	.34	3.32	3.24	10.62±0.13	10.33±0.11	1.27±0.04	1.17±0.01	7.84	8.94	8.94	0
May 6-11	.30	.33	.33	.30	3.41	3.42	10.54±0.15	10.48±0.17	1.22±0.02	.98±0.02	8.70	9.14	9.14	0

¹ Each figure represents a mean of 50 or 75 determinations for 1939-40, 1940-41, and 1941-42.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁵ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.⁶ Each figure represents a mean of duplicate determinations.

TABLE 21.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock at Bradenton, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}			Flesh color ^{2,4}			Flesh texture ^{2,5}				Diameter of fruit ²			Rind thickness ²			
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42
	Gm.	C	D	B	B	GY	GY	GY	Ricey	Ricey	Ricey	Ricey	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
Aug. 25-Sept. 2	246	C	D	B	B	GY	GY	GY	Ricey	Ricey	Ricey	Ricey	92	88	81	7	6	7
Sept. 25-30	294	D	E	C	B	PY	PY	PY	Coarse	Coarse	Coarse	Coarse	95	87	87	6	6	6
Oct. 23-28	360	E	F	C	E	PY	PY	PY	Good	Good	Good	Good	99	98	94	5	6	5
Nov. 20-25	443	F	F	E	E	PY	PY	PY	do	do	do	do	107	105	102	6	6	5
Dec. 18-23	501	F	F	E	F	TY	TY	TY	do	do	do	do	109	110	108	6	7	6
Jan. 15-20	515	F	F	F	F	TY	TY	TY	do	do	do	do	110	110	111	8	6	5
Feb. 12-17	529	F	F	F	F	TY	TY	TY	do	do	do	do	109	116	110	8	6	5
Mar. 11-16	545	G	H	H	G	TY	TY	TY	F(16)	do	do	do	112	115	110	8	6	5
Apr. 8-13	555	G	H	F	G	TY	TY	TY	F(4)	do	do	do	114	114	110	8	7	6
May 6-11	575	G	H	F	G	TY	TY	TY	F(24)	do	do	do	116	118	110	8	7	6
Picking period	Juice per 100 grams of fruit ⁶	Flavor ^{2,4}			Total ash ⁷			Ascorbic acid per milliliter ⁷			Active acidity ⁷							
		1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1942-43				
	Ml.	V acid	V acid	V acid	V acid	V acid	V acid	Pct.	Pct.	Pct.	Mg.	Mg.	Mg.	pH	pH	pH	pH	pH
Aug. 25-Sept. 2	30	V acid	V acid	V acid	V acid	V acid	V acid	0.308	0.318	0.310	0.57	0.69	0.53	3.02	3.13	3.13	3.05	3.05
Sept. 25-30	40	Acid	Acid	Acid	do	do	do	.51	.51	.51	.49	.53	.53	3.00	3.15	3.10	2.95	2.95
Oct. 23-28	45	Tart	Tart	Tart	Acid	Acid	Acid	.45	.45	.307	.44	.47	.47	3.05	3.00	3.13	2.92	2.92
Nov. 20-25	46	P tart	do	do	do	do	do	.44	.46	.309	.46	.46	.46	3.04	3.03	3.03	2.95	2.93
Dec. 18-23	49	do	do	do	Tart	do	do	.225	.239	.218	.39	.46	.46	3.02	3.00	3.09	2.93	2.93
Jan. 15-20	48	do	do	do	P tart	do	do	.248	.248	.255	.41	.35	.46	3.03	2.97	3.17	3.00	3.00
Feb. 12-17	48	do	do	do	do	do	do	.41	.41	.255	.41	.35	.46	3.03	3.10	3.21	3.05	3.05
Mar. 11-16	49	do	do	do	do	do	do	.39	.39	.259	.38	.36	.45	3.09	3.19	3.25	3.07	3.07
Apr. 8-13	49	do	do	do	do	do	do	.38	.38	.259	.38	.36	.45	3.11	3.13	3.40	3.08	3.08
May 6-11	51	do	do	do	do	do	do	.38	.38	.259	.38	.36	.41	3.25	3.14	3.48	3.22	3.22

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.
² Each figure or description represents a mean of 25 determinations for 1 season.
³ See U. S. Department of Agriculture color chart (pl. 4).
⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.
⁵ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.
⁶ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.
⁷ Each figure represents a mean of duplicate determinations.

Picking period	Total solids ²				Total acid ²				Solids-acid ratio				Fruit below solids-acid ratio			
	1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1939-40		1940-41	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Aug. 25-Sept. 2.....	8.53±0.11	8.79±0.07	9.56±0.12	10.21	1.80±0.03	1.87±0.04	2.04	4.93	4.88	5.11	5.00	96	100	100	100	100
Sept. 25-30.....	9.39±0.06	9.00±0.10	9.03±0.09	9.87	1.67±0.02	1.54±0.03	1.55	6.34	5.39	5.86	6.37	88	100	100	100	100
Oct. 23-28.....	9.26±0.05	9.29±0.11	9.21±0.12	11.13	1.63±0.03	1.26±0.02	1.74	7.29	5.70	7.31	6.40	12	96	16	16	16
Nov. 20-25.....	9.31±0.07	9.69±0.04	9.68±0.13	11.17	1.32±0.01	1.27±0.02	1.67	7.05	6.29	7.62	6.69	44	56	4	4	4
Dec. 18-23.....	9.55±0.07	9.31±0.15	9.94±0.06	11.09	1.35±0.02	1.25±0.02	1.47	7.07	6.29	7.95	7.54	24	24	60	0	0
Jan. 15-20.....	9.27±0.05	9.76±0.12	10.42±0.07	11.13	1.30±0.01	1.16±0.02	1.42	7.13	6.73	8.98	7.57	24	24	40	0	0
Feb. 12-17.....	9.35±0.05	9.28±0.18	10.20±0.11	11.30	1.32±0.02	1.09±0.02	1.47	7.08	6.36	9.36	7.96	20	48	0	0	0
Mar. 11-16.....	9.12±0.06	9.42±0.19	10.63±0.15	11.40	1.25±0.02	1.02±0.02	1.41	7.30	6.98	10.42	8.09	16	44	0	0	0
Apr. 8-13.....	8.68±0.10	9.53±0.25	10.67±0.15	11.56	1.16±0.02	0.89±0.02	1.36	7.48	7.27	11.99	8.50	8	24	0	0	0
May 6-11.....	8.79±0.11	8.92±0.14	10.72±0.11	11.35	1.09±0.02	0.81±0.01	1.24	8.06	7.89	13.23	9.15	0	16	0	0	0

² Each figure or description represents a mean of 25 determinations for 1 season.

TABLE 22.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock at Vero Beach, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}				Flesh color ^{2,4}				Flesh texture ^{2,5}				Diameter of fruit ²				Rind thickness ²			
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43
	<i>Gm.</i>	C	D	C	B	PY	PY	PY	PY	Coarse	Ricey	Ricey	Ricey	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
Aug. 25-Sept. 2.....	268									do.	do.	do.	do.	96	91	82	8	6	6	7	7
Sept. 25-30.....	326	D	D	C	B	PY	PY	PY	PY	Good	Coarse	Coarse	Coarse	101	95	88	7	6	6	5	5
Oct. 23-28.....	393	D	E	D	D	PY	PY	PY	PY	Good	Good	Coarse	Coarse	106	102	94	6	6	6	5	5
Nov. 20-25.....	492	F	F	F	E	PY	PY	PY	PY	do.	do.	do.	do.	113	109	104	6	6	6	5	5
Dec. 18-23.....	553	G	F	F	F	PY	PY	PY	PY	do.	do.	do.	Good	117	113	110	7	6	6	4	4
Jan. 15-20.....	588	G	F	F	G	PY	PY	PY	PY	do.	do.	do.	do.	123	114	114	7	6	6	5	5
Feb. 12-17.....	599	G	F	G	G	PY	PY	PY	PY	F (4)	do.	do.	do.	120	116	112	7	6	6	5	5
Mar. 11-16.....	598	G	G	G	G	PY	PY	PY	PY	F (20)	do.	do.	do.	119	118	113	8	6	6	5	5
Apr. 8-13.....	612	G	G	G	G	PY	PY	PY	PY	F (20)	do.	do.	do.	117	118	117	9	6	6	4	4
May 6-11.....	633	G	G	G	G	PY	PY	PY	PY	F (44)	do.	do.	do.	117	125	115	8	7	6	6	6

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.

² Each figure or description represents a mean of 25 determinations for 1 season.

³ See U. S. Department of Agriculture color chart (pl. 4).

⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.

⁵ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.

TABLE 23.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock at Homestead, Fla., grove 2, 1941-42

Picking period	Weight per fruit ¹	Rind color ^{1,2}	Flesh color ^{1,3}	Flesh texture ¹	Diam-eter of fruit ¹	Rind thick-ness ¹	Juice per 100 grams of fruit ⁴	Flavor ^{1,3}	Total ash ⁵	Ascor-bic acid per mil-liliter ⁵	Active acid-ity ⁵	Total solids ¹	Total acid ¹	Solids-acid ratio	Fruit below solids-acid ratio
	Gm.				Mm.	Mm.	Ml.		Percent	Mg.	pH	Percent	Percent		Percent
Aug. 25-Sept. 2.....	248	C	GY	Ricey	86	7	33	V acid	0.276	0.63	3.14	10.27±0.03	1.83±0.03	5.61	96
Sept. 25-30.....	329	D	GY	do	94	7	43	Tart	.....	.51	3.14	10.23±0.05	1.48±0.05	6.91	32
Oct. 23-28.....	412	D	GY	do	100	7	39	P tart	.244	.49	3.08	9.90±0.06	1.26±0.02	7.86	0
Nov. 20-25.....	522	F	PY	Coarse	109	6	40	do	.....	.47	3.10	9.85±0.08	1.16±0.02	8.49	0
Dec. 18-23.....	586	F	PY	do	114	7	56	do	.....	.43	3.10	9.74±0.06	1.06±0.02	9.19	0
Jan. 15-20.....	609	F	TY	Good	116	6	47	do	.....	.41	3.22	10.01±0.08	1.00±0.02	10.01	0
Feb. 12-17.....	645	F	TY	do	117	6	50	P tart to S	.155	.42	3.22	10.23±0.10	1.02±0.02	10.23	0
Mar. 11-16.....	641	F	TY	do	117	7	50	do	.....	.43	3.22	10.44±0.10	1.00±0.02	10.24	0
Apr. 8-13.....	693	F	TY	do	121	7	48	do	.....	.40	3.31	10.24±0.12	.86±0.01	11.91	0
May 6-11.....	726	F	TY	do	124	8	50	P tart, W (overripe)	.180	.43	3.41	9.72±0.11	.83±0.01	11.71	0

¹ Each figure or description represents a mean of 25 determinations for 1 season.² See U. S. Department of Agriculture color chart (pl. 4).³ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁴ Each figure represents a mean of 25 determinations for 1 season; juice extracted by means of an electric reamer.⁵ Each figure represents a mean of duplicate determinations.

TABLE 24.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock at Davenport, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}			Flesh color ^{2,4}			Flesh texture ^{2,5}			Diameter of fruit ²			Rind thickness ²		
		1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42
	Gm.										Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
Aug. 25-Sept. 2.....	355	A	B	C	GY	GY	GY	Ricey	Coarse	Ricey	86	94	98	9	7	8
Sept. 25-30.....	411	D	C	D	GY	GY	GY	do	Coarse	do	104	89	98	8	7	8
Oct. 23-28.....	490	E	D	E	PY	PY	PY	do	Coarse	do	109	103	106	8	7	8
Nov. 20-25.....	542	F	F	F	TY	TY	TY	Good	Good	Coarse	113	113	118	8	7	7
Dec. 18-23.....	589	F	F	F	TY	TY	TY	do	do	Good	122	113	121	9	7	7
Jan. 15-20.....	652	F	F	F	TY	TY	TY	do	do	do	122	117	121	10	7	7
Feb. 12-17.....	690	F	F	F	TY	TY	TY	F (56)	do	do	123	120	121	9	7	7
Mar. 11-16.....	709	F	F	F	TY	TY	TY	F (24)	do	do	119	124	124	10	8	8
Apr. 8-13.....	743	F	F	F	TY	TY	TY	F (48)	do	do	121	124	124	10	8	8
May 6-11.....	757	F	F	F	TY	TY	TY	F (32)	do	do	121	125	126	10	8	8

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁵ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.

TABLE 24.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock at Davenport, Fla., 1939-43—Continued

Picking period	Juice per 100 grams of fruit ⁶	Flavor ^{2,4}			Total ash ⁷			Ascorbic acid per milliliter ⁷				Active acidity ⁷				
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43			
	<i>Ml.</i>	V acid..... Acid..... Tart..... do..... P tart..... do..... do..... do..... do..... do..... do..... do..... do..... do..... do.....	V acid..... Tart..... do..... do..... P tart..... do..... do..... do..... do..... do..... do..... do..... do..... do..... do.....	V acid..... Acid..... Tart..... do..... P tart..... do..... do..... do..... do..... do..... do..... do..... do..... do..... do.....	V acid..... do..... Acid..... do..... Tart..... do..... do..... do..... do..... do..... do..... do..... do..... do..... do.....	<i>Pd.</i> 0.312 .367...........271	<i>Pd.</i> 0.364 .347...........336	<i>Pd.</i> 0.415 .347...........250	<i>Mg.</i> 0.46 .45...........42	<i>Mg.</i> 0.48 .46...........44	<i>Mg.</i> 0.45 .48...........42	<i>Mg.</i> 0.54 .51...........49	<i>pH</i> 3.32 3.30 3.34 3.32 3.33 3.32 3.33 3.32 3.33 3.32 3.33 3.32 3.33 3.32	<i>pH</i> 3.30 3.30 3.34 3.32 3.27 3.22 3.20 3.20 3.20 3.20 3.20 3.20 3.20 3.20 3.20	<i>pH</i> 3.25 3.14 3.14 3.15 3.15 3.15 3.15 3.11 3.11 3.12 3.12 3.12 3.12 3.16 3.26	<i>pH</i> 3.07 3.08 3.04 3.10 3.11 3.11 3.11 3.11 3.12 3.12 3.12 3.12 3.16 3.26
		Total solids ²			Total acid ²			Solids-acid ratio				Fruit below solids-acid ratio				
		1939-40	1940-41	1941-42	1942-43	1939-40	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43
Aug. 25-Sept. 2.....	<i>Pd.</i> 7.53±0.10	<i>Pd.</i> 8.20±0.07	<i>Pd.</i> 8.76±0.09	<i>Pd.</i> 8.87	<i>Pd.</i> 1.39±0.02	<i>Pd.</i> 1.66±0.03	<i>Pd.</i> 1.51±0.02	<i>Pd.</i> 1.73	5.42	5.15	5.28	5.13	100	100	100	100
Sept. 25-30.....	7.77±0.07	8.54±0.07	8.75±0.07	8.73	2.00±0.02	1.59±0.02	1.49±0.02	1.49	6.48	5.47	5.79	5.86	120	96	60	48
Oct. 23-28.....	8.41±0.07	9.24±0.10	9.35±0.10	9.62	1.09±0.01	1.55±0.03	1.59±0.02	1.59	7.72	5.96	6.82	6.41	8	60	32	8
Nov. 20-25.....	8.66±0.08	9.41±0.09	9.45±0.07	10.03	1.07±0.01	1.47±0.03	1.37±0.02	1.57	8.09	6.40	7.05	6.37	8	60	32	8
Dec. 18-23.....	9.32±0.08	9.63±0.12	9.21±0.09	10.67	1.09±0.01	1.48±0.03	1.25±0.02	1.53	8.55	6.51	7.37	6.97	0	64	8	0
Jan. 15-20.....	9.30±0.10	9.86±0.13	9.88±0.11	10.67	1.14±0.01	1.52±0.03	1.54±0.02	1.54	8.16	6.44	8.10	6.93	0	48	0	0
Feb. 12-17.....	9.07±0.10	9.71±0.13	10.05±0.10	10.62	1.07±0.02	1.49±0.02	1.20±0.02	1.50	8.48	6.84	8.38	7.08	0	36	0	0
Mar. 11-16.....	9.02±0.08	9.96±0.17	10.37±0.11	10.75	.99±0.02	1.20±0.02	1.41±0.02	1.43	9.11	7.06	9.10	7.52	4	20	8	0
Apr. 8-13.....	8.78±0.09	9.89±0.11	9.63±0.11	10.27	.91±0.02	1.41±0.02	1.32±0.02	1.31	9.65	7.49	9.08	7.84	0	8	0	0
May 6-11.....	8.58±0.10	9.54±0.12	9.62±0.13	10.05	.82±0.02	1.21±0.02	.95±0.02	1.20	10.46	7.88	10.13	8.38	0	12	0	0

² Each figure or description represents a mean of 25 determinations for 1 season.⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly;

S, sweet; W, watery.

⁶ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.⁷ Each figure represents a mean of duplicate determinations.

TABLE 25.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock at Lake Hamilton, Fla., 1940-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}			Flesh color ^{2,4}			Flesh texture ²			Diameter of fruit ²		Rind thickness ²		Juice per 100 grams of fruit ⁵		Flavor ^{2,4}		
		1940-41		1942-43	1940-41		1942-43	1940-41		1942-43	1940-41		1940-41	1941-42	1940-41		1940-41	1941-42	1942-43
		1940-41	1941-42	1942-43	1940-41	1941-42	1942-43	1940-41	1941-42	1942-43	1940-41	1941-42	1940-41	1941-42	1940-41	1941-42	1940-41	1941-42	1942-43
Picking period	Total ash ⁶	Ascorbic acid per milliliter ⁶			Active acidity ⁶			Total solids ²			Total acid ²			Solids-acid ratio			Fruit below solids-acid ratio		
		1940-41	1941-42	1942-43	1940-41	1941-42	1942-43	1940-41	1941-42	1942-43	1940-41	1941-42	1942-43	1940-41	1941-42	1942-43	1940-41	1941-42	1942-43
		Per cent	Mg.	Mg.	pH	pH	pH	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Aug. 25-Sept. 2	310	0.434	0.51	0.52	3.16	3.07	3.07	9.47±0.02	9.98	9.98	1.69±0.03	1.95±0.02	1.86	4.86	5.37	100			
Sept. 25-30	379		.46	.46	3.21	3.18	2.99	9.26±0.07	9.73	9.73	1.63±0.01	1.63±0.01	1.75	5.59	5.56	100			
Oct. 23-28	435		.45	.45	3.18	3.10	3.05	10.46±0.08	10.63	10.63	1.77±0.04	1.77±0.04	1.85	5.91	5.68	96			
Nov. 20-25	501		.45	.47	3.21	3.13	3.04	10.87±0.10	11.18	11.18	1.75±0.02	1.39±0.02	1.99	5.21	5.75	84			
Dec. 18-23	571		.37	.43	3.20	3.15	3.08	11.40±0.09	10.84	10.84	1.77±0.03	1.39±0.02	1.78	6.44	6.93	84			
Jan. 15-20	589		.38	.43	3.25	3.13	3.05	11.46±0.10	10.84	10.84	1.71±0.03	1.37±0.02	1.79	6.74	6.67	60			
Feb. 12-17	631		.38	.44	3.21	3.18	3.05	11.69±0.14	10.92	10.92	1.70±0.03	1.34±0.01	1.70	6.88	7.69	40			
Mar. 11-16	651		.37	.43	3.27	3.18	3.12	11.30±0.10	10.10	10.10	1.62±0.02	1.28±0.02	1.54	6.98	8.20	4			
Apr. 8-13	717		.40	.39	3.28	3.21	3.12	11.31±0.12	9.77	9.77	1.54±0.03	1.25±0.02	1.39	7.87	8.25	24			
May 6-11	740		.34	.35	3.38	3.29	3.19	11.10±0.15	9.59	9.59	1.41±0.02	1.18±0.02	1.33	7.87	8.65	12			
			.36					10.21±0.14								7.21			

¹ Each figure represents a mean of 50 or 75 determinations for 1940-41, 1941-42, and 1942-43.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁵ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.⁶ Each figure represents a mean of duplicate determinations.

TABLE 26.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on rough lemon rootstock at Palmetto, Fla., 1939-43

Picking period	Weight, per fruit ¹	Rind color ^{2,3}			Flesh color ^{2,4}			Flesh texture ⁵				Diameter of fruit ²				Rind thickness ²	
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43			1939-40	1940-41	1941-42	1942-43	1939-40	1940-41
Aug. 25-Sept. 2	Gm. 311	C	B	B	GY	GY	GY	GY	GY	Ricey	Ricey	Mm. 89	Mm. 86	Mm. 86	Mm. 86	Mm. 7	Mm. 7
Sept. 25-30	374	D	C	C	GY	GY	GY	GY	GY	Coarse	Coarse	89	93	91	91	6	6
Oct. 23-28	420	E	D	D	PY	PY	PY	PY	PY	Good	Coarse	106	96	97	97	6	6
Nov. 20-25	511	F	E	E	PY	PY	PY	PY	PY	do	Good	114	104	110	110	6	6
Dec. 18-23	539	F	F	F	TY	TY	TY	TY	TY	do	Good	115	104	110	117	6	6
Jan. 15-20	604	G	F	F	TY	TY	TY	TY	TY	do	do	117	106	111	114	6	6
Feb. 12-17	612	G	F	F	TY	TY	TY	TY	TY	do	do	119	109	114	114	6	6
Mar. 11-16	624	H	F	F	TY	TY	TY	TY	TY	do	do	117	114	119	114	6	6
Apr. 8-13	665	H	F	F	TY	TY	TY	TY	TY	do	do	114	114	119	114	7	7
May 6-11	644	G	F	F	TY	TY	TY	TY	TY	do	do	115	114	121	114	8	8

Picking period	Juice per 100 grams of fruit ²	Flavor ^{2,4}			Total ash ⁶		Ascorbic acid per milliliter ⁶				Active acidity ⁶			
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1943-44	1944-45	1945-46	1946-47	1947-48
Aug. 25-Sept. 2	Ml. 34	V acid	V acid	V acid	V acid	Pct. 0.418	Pct. 0.361	Pct. 0.400	Pct. 0.43	Mg. 0.47	Mg. 0.48	pH 3.24	pH 3.28	pH 3.15
Sept. 25-30	44	Acid	Acid	Acid	Acid	384	397	410	38	41	45	3.17	3.18	3.15
Oct. 23-28	44	Tart	Tart	Tart	Tart	384	397	410	36	42	45	3.17	3.18	3.15
Nov. 20-25	50	P tart	do	do	do	384	397	410	37	40	43	3.18	3.22	3.17
Dec. 18-23	49	do	do	do	do	387	355	314	36	37	43	3.16	3.21	3.17
Jan. 15-20	48	do	P tart, W	do	P tart	286	314	256	36	37	41	3.20	3.24	3.19
Feb. 12-17	48	do	do	do	P tart to S	351	368	336	33	33	35	3.21	3.28	3.27
Mar. 11-16	48	P tart to S	do	do	do	351	368	336	33	33	35	3.21	3.31	3.21
Apr. 8-13	48	do	do	do	do	351	368	336	33	33	35	3.28	3.28	3.31
May 6-11	49	do	do	do	do	351	368	336	37	32	34	3.50	3.38	3.34

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁵ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.⁶ Each figure represents a mean of duplicate determinations.

Picking period	Total solids ²				Total acid ²				Solids-acid ratio				Fruit below solids-acid ratio	
	1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1939-40	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Aug. 25-Sept. 2.....	8.47±0.09	7.88±0.10	8.97±0.05	8.34	1.78±0.03	1.71±0.02	1.73	5.26	4.43	5.25	4.82	100	100	104-42
Sept. 25-30.....	9.38±0.06	7.88±0.11	9.35±0.06	8.77	1.64±0.02	1.60±0.02	1.47	6.80	4.80	5.84	5.97	100	100	92
Oct. 23-28.....	9.47±0.07	8.70±0.10	9.08±0.06	8.97	1.72±0.02	1.43±0.02	1.47	7.23	5.06	6.35	6.78	100	100	100
Nov. 20-25.....	10.21±0.07	8.90±0.10	9.46±0.07	10.63	1.32±0.02	1.31±0.02	1.38	7.73	5.74	7.22	7.70	100	100	72
Dec. 18-23.....	10.51±0.09	9.29±0.13	9.82±0.07	10.67	1.61±0.03	1.61±0.02	1.39	7.96	5.77	7.74	7.68	100	100	24
Jan. 15-20.....	10.02±0.12	8.40±0.10	9.21±0.11	10.87	1.55±0.02	1.17±0.02	1.37	7.48	6.06	8.73	7.20	12	96	0
Feb. 12-17.....	11.08±0.14	9.32±0.10	10.61±0.12	10.30	1.49±0.02	1.16±0.02	1.35	8.59	6.26	8.63	7.63	4	92	0
Mar. 11-16.....	11.02±0.10	9.47±0.10	10.32±0.13	10.63	1.27±0.02	1.07±0.03	1.40	8.68	6.36	9.64	7.59	0	72	4
Apr. 8-13.....	10.61±0.14	9.16±0.10	10.15±0.16	10.62	1.15±0.02	1.08±0.03	1.25	9.23	6.54	9.40	8.50	0	84	0
May 6-11.....	10.63±0.13	9.34±0.13	10.74±0.14	10.68	1.37±0.02	1.10±0.02	1.22	10.42	6.82	9.76	8.75	0	48	0

² Each figure or description represents a mean of 25 determinations for 1 season.

TABLE 27.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on rough lemon rootstock at Fort Pierce, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}				Flesh color ^{2,4}				Flesh texture ^{2,5}				Diameter of fruit ²				Rind thickness ²	
		1939-40		1940-41		1939-40		1941-42		1939-40		1940-41		1939-40		1941-42		1939-40	
		Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.	Gm.
Aug. 25-Sept. 2.....	315	C	B	C	B	C	C	C	C	Ricey	do.	Ricey	do.	Ricey	do.	Ricey	do.	8	7
Sept. 25-30.....	373	D	D	D	D	G	G	G	G	Coarse	do.	Coarse	do.	Coarse	do.	Coarse	do.	7	6
Oct. 23-28.....	465	E	D	E	E	P	P	P	P	do.	do.	Coarse	do.	Coarse	do.	Coarse	do.	7	6
Nov. 20-25.....	532	D	E	E	E	P	P	P	P	do.	do.	Good	do.	Good	do.	Good	do.	7	6
Dec. 18-23.....	588	F	F	F	F	P	P	P	P	do.	do.	do.	do.	do.	do.	do.	do.	8	6
Jan. 15-20.....	644	F	F	F	F	T	T	T	T	do.	do.	do.	do.	do.	do.	do.	do.	8	6
Feb. 12-17.....	653	F	F	F	F	T	T	T	T	do.	do.	do.	do.	do.	do.	do.	do.	9	6
Mar. 11-16.....	673	F	F	F	F	T	T	T	T	do.	do.	do.	do.	do.	do.	do.	do.	9	6
Apr. 8-13.....	731	G	F	F	F	T	T	T	T	do.	do.	do.	do.	do.	do.	do.	do.	10	7
May 6-11.....	773	G	F	F	F	T	T	T	T	do.	do.	do.	do.	do.	do.	do.	do.	10	7

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.

² Each figure or description represents a mean of 25 determinations for 1 season.

³ See U. S. Department of Agriculture color chart (pl. 4).

⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; F, pleasantly; S, sweet; W, watery.

⁵ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.

TABLE 27.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on rough lemon rootstock at Fort Pierce, Fla., 1939–1943—Continued

Picking period	Juice per 100 grams of fruit %	Flavor 2 4			Total ash 7			Ascorbic acid per milliliter 7			Active acidity 7					
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43			
	<i>Mt.</i>	V acid..... Acid..... Tart..... do..... P tart, W..... do..... do..... do.....	V acid..... Acid..... Tart..... do..... P tart..... do..... do..... do.....	V acid..... Acid..... Tart..... do..... P tart..... do..... do..... do.....	V acid..... Acid..... Tart..... do..... P tart..... do..... do..... do.....	<i>Pct.</i> 0.304	<i>Pct.</i> 0.449	<i>Pct.</i> 0.450	<i>Mg.</i> 0.41	<i>Mg.</i> 0.44	<i>Mg.</i> 0.46	<i>pH</i> 3.19 3.17 3.12 3.15 3.13 3.12 3.20 3.21 3.24 3.21	<i>pH</i> 3.04 3.04 3.17 3.17 3.19 3.18 3.20 3.20 3.25 3.33	<i>pH</i> 3.05 3.07 3.00 3.07 3.04 3.08 3.07 3.04 3.09 3.18		
		Total solids 2			Total acid 2			Solids-acid ratio			Fruit below solids-acid ratio					
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42
	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>
Aug. 25-Sept. 2	7.43±0.09	8.33±0.14	8.01±0.07	8.98	1.53±0.03	1.83±0.04	1.82±0.01	1.79	4.86	4.55	4.40	5.02	100	100	100	100
Sept. 25-30	7.48±0.07	8.34±0.10	9.49±0.05	8.63	1.41±0.03	1.78±0.02	1.50±0.02	1.52	5.30	4.69	6.33	5.68	100	100	100	72
Oct. 23-28	7.25±0.07	9.11±0.14	9.59±0.07	10.39	1.25±0.02	1.73±0.02	1.35±0.03	1.73	5.80	5.27	7.10	5.82	100	100	100	32
Nov. 20-25	7.72±0.06	9.74±0.06	9.76±0.09	10.39	1.23±0.02	1.68±0.02	1.26±0.02	1.66	6.28	5.80	7.75	6.26	96	100	100	0
Dec. 18-23	7.78±0.08	9.76±0.10	9.71±0.09	10.62	1.25±0.01	1.66±0.02	1.24±0.02	1.56	6.22	5.88	7.83	6.81	100	92	100	0
Jan. 15-20	8.37±0.08	10.30±0.11	10.01±0.09	10.10	1.18±0.02	1.74±0.02	1.12±0.02	1.54	7.09	5.92	8.94	6.56	100	92	92	0
Feb. 12-17	8.03±0.07	10.23±0.14	10.25±0.09	9.98	1.20±0.01	1.60±0.02	1.11±0.02	1.49	6.69	6.39	9.23	6.70	72	64	64	0
Mar. 11-16	7.65±0.07	10.50±0.11	10.13±0.12	10.35	1.16±0.02	1.60±0.02	1.09±0.02	1.53	6.59	6.56	9.29	6.76	72	32	32	0
Apr. 8-13	7.74±0.07	10.24±0.10	10.04±0.17	9.70	1.12±0.02	1.47±0.03	1.02±0.02	1.33	6.91	6.96	9.84	7.29	52	16	16	0
May 6-11	7.57±0.10	10.12±0.12	10.01±0.16	9.95	1.03±0.01	1.39±0.04	.99±0.02	1.29	7.35	7.28	10.11	7.71	20	16	16	0

² Each figure or description represents a mean of 25 determinations for 1 season.⁵ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.⁷ Each figure represents a mean of duplicate determinations.

S, sweet; W, watery.

TABLE 28.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock at Homestead, Fla., grove 1, 1939-42

Picking period	Weight per fruit ¹	Rind color ^{2,3}			Flesh color ^{2,4}			Flesh texture ^{2,5}			Diameter of fruit ²			Rind thickness ²			Juice per 100 grams of fruit ⁶	Flavor ^{2,4}		
		1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42		1939-40	1940-41	1941-42
Aug. 25-Sept. 2	Gm. 327	D	C		GY	GY		Riccy	Coarse		Mm.	89	Mm.	7	6		Ml. 38	V acid		
Sept. 25-30	350	E	D		PY	GY		Coarse			95	91		7	6		43	Acid		
Oct. 23-28	435	E	E		PY	TY		Good			104	100		6	6		38	Tart		Tart.
Nov. 20-25	493	F	E		PY	TY		Good			109	104		6	6		45	P tart.		Do.
Dec. 18-23	558	F	F		PY	TY		do.			111	108		6	7		47	do.		Do.
Jan. 15-20	578	F	F		TY	TY		do.			113	109		6	6		50	do.		P tart.
Feb. 12-17	607	F	F		TY	TY		F (8)			115	111		8	6		48	do.		Do.
Mar. 11-16	542	F	F		TY	TY		do.			108	108		6	6		49	do.		P tart to S.
Apr. 8-13	551	F	F		TY	TY		do.			111	111		7	11		51	do.		do.
May 6-11	626	F	F		TY	TY		do.			116	116		8	8		50	do.		do.

Picking period	Total ash ⁷		Ascorbic acid per milliliter ⁷		Active acidity ⁷		Total solids		Total acid ²			Solids-acid ratio			Fruit below solids-acid ratio		
	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42	1939-40	1940-41	1941-42
Aug. 25-Sept. 2	Pct. 0.384	0.321	Mg. 0.42	0.39	pH 3.14	3.25	Pct. 8.41±0.04		Pct. 1.66±0.03			Pct. 5.64	5.07		Pct. 96	100	Pct.
Sept. 25-30	0.384	0.321	0.38	0.39	3.12	3.20	9.35±0.10		1.53±0.02			5.90	5.61		96	100	
Oct. 23-28	0.338	0.373	0.42	0.41	3.14	3.22	9.02±0.13		1.48±0.02			6.79	6.28		96	100	
Nov. 20-25	0.296	0.289	0.39	0.40	3.17	3.23	9.21±0.10		1.37±0.04			6.92	6.52		94	100	
Dec. 18-23	0.261	0.292	0.38	0.41	3.19	3.22	10.08±0.16		1.35±0.02			6.72	6.73		94	100	
Jan. 15-20	0.261	0.292	0.40	0.39	3.10	3.22	10.50±0.20		1.40±0.02			7.19	6.95		8	24	
Feb. 12-17	0.261	0.292	0.37	0.40	3.21	3.30	10.59±0.12		1.36±0.02			7.79	7.06		8	24	
Mar. 11-16	0.363	0.363	0.37	0.37	3.17	3.28	10.74±0.22		1.51±0.03			7.25	8.03		4	16	
Apr. 8-13	0.363	0.363	0.37	0.37	3.28	3.32	11.04±0.26		1.57±0.03			7.50	7.50		4	16	
May 6-11	0.363	0.363	0.40	0.40	3.32	3.42	10.87±0.19		1.43±0.03			7.21	7.21		0	0	
							10.56±0.17		1.24±0.03			8.52	8.52		0	0	

¹ Each figure represents a mean of from 25 to 75 determinations for 1939-40, 1940-41, and 1941-42.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁵ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.⁶ Each figure represents a mean of 25 or 50 determinations for 2 seasons; juice extracted by means of an electric reamer.⁷ Each figure represents a mean of duplicate determinations.

TABLE 20.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on sour orange rootstock at Davenport, Fla., 1939-42

Picking period	Weight per fruit ¹	Rind color ^{2,3}		Flesh color ^{2,4}		Flesh texture ^{2,5}		Diameter of fruit ²		Rind thickness ²		Juice per 100 grams of fruit ⁶	Flavor ^{2,4}				
		1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1941-42	1939-40		1940-41	1941-42			
	<i>Gm.</i>	A	C	B	C	GY	GY	Ricey	Ricey	Coarse	Good	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	V acid.	V acid.	V acid.
Aug. 25-Sept. 2	335	D	C	C	C	PY	GY	do	do	do	do	95	94	8	7	31	Tart.
Sept. 25-30	381	E	E	D	E	PY	PY	Coarse	Coarse	Coarse	Good	97	93	8	7	38	Do.
Oct. 23-28	468	F	F	D	F	TY	TY	do	do	do	do	108	101	7	6	42	P tart.
Nov. 20-25	538	F	F	F	F	PY	TY	do	do	do	do	108	106	6	7	43	Do.
Dec. 18-23	599	F	F	F	F	TY	TY	do	do	do	do	113	108	8	7	44	P tart.
Jan. 15-20	622	F	F	G	G	TY	TY	do	do	do	do	116	112	9	8	46	Do.
Feb. 12-17	666	F	F	G	G	TY	TY	do	do	do	do	121	115	10	8	42	Do.
Mar. 11-16	693	G	H	H	H	TY	TY	do	do	do	do	120	118	10	9	43	P tart to S.
Apr. 8-13	699	G	H	H	H	TY	TY	do	do	do	do	114	121	9	8	46	Do.
May 6-11	810	G	H	G	G	TY	TY	do	do	do	do	122	132	8	7	46	P tart to S (overripe).

Picking period	Total ash ⁷		Ascorbic acid per milliliter ⁷		Active acidity ⁷		Total solids ²		Total acid ²		Solids-acid ratio		Fruit below solids-acid ratio				
	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1941-42	Percent	Percent	Percent	Percent	Percent	Percent
Aug. 25-Sept. 2	0.370	0.315	0.489	0.43	3.24	3.30	8.71±0.06	9.60±0.07	9.39±0.10	1.73±0.02	1.78±0.03	5.03	5.39	5.05	100	96	100
Sept. 25-30	0.375	0.374	0.408	0.42	3.21	3.15	8.91±0.06	10.00±0.07	10.80±0.11	1.43±0.02	1.79±0.03	6.02	5.59	5.47	82	88	100
Oct. 23-28	0.375	0.374	0.408	0.41	3.25	3.17	9.76±0.11	10.07±0.07	10.57±0.04	1.33±0.02	1.79±0.03	7.33	5.63	6.48	20	88	64
Nov. 20-25	0.280	0.337	0.315	0.40	3.27	3.22	10.76±0.09	11.17±0.06	11.25±0.11	1.39±0.03	1.73±0.03	7.37	6.46	7.12	16	28	16
Dec. 18-23	0.280	0.337	0.315	0.40	3.27	3.22	10.76±0.09	11.37±0.06	11.04±0.09	1.40±0.03	1.73±0.03	7.69	6.61	7.06	0	20	0
Jan. 15-20	0.270	0.391	0.313	0.36	3.31	3.26	11.05±0.09	11.24±0.11	11.72±0.14	1.38±0.03	1.69±0.03	7.64	6.65	7.81	0	0	0
Feb. 12-17	0.303	0.391	0.313	0.36	3.31	3.31	11.55±0.10	11.33±0.11	12.35±0.18	1.17±0.02	1.60±0.02	9.43	7.08	8.76	0	0	0
Mar. 11-16	0.303	0.377	0.312	0.33	3.32	3.32	11.51±0.09	11.22±0.11	12.24±0.15	1.16±0.02	1.62±0.02	9.83	6.93	8.93	0	16	0
Apr. 8-13	0.303	0.377	0.312	0.33	3.33	3.33	11.21±0.09	11.87±0.13	11.86±0.18	1.14±0.02	1.57±0.03	9.66	7.56	9.19	0	4	0
May 6-11	0.303	0.377	0.312	0.33	3.43	3.43	11.18±0.15	12.04±0.14	12.04±0.14	1.40±0.03	1.14±0.03	7.99	10.56	0	0	0	0

¹ Each figure represents a mean of 50 or 75 determinations for 1939-40, 1940-41, and 1941-42.

² Each figure or description represents a mean of 25 determinations for 1 season.

³ See U. S. Department of Agriculture color chart (pl. 4).

⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.

⁵ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.

⁶ Each figure represents a mean of 50 determinations for 2 seasons; juice extracted by means of an electric reamer.

⁷ Each figure represents a mean of duplicate determinations.

TABLE 30.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on sour orange rootstock at Palmetto, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}				Flesh color ^{2,4}				Flesh texture ⁵				Diameter of fruit ²				Rind thickness ²							
		1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42		1942-43	
		Gm.	A	C	D	C	C	B	GY	GY	GY	GY	Ricey	Coarse	do	Ricey	Coarse	do	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.	Mm.
Aug. 25-Sept. 2	311	A	C	D	C	C	B	GY	GY	GY	GY	Ricey	Coarse	do <td>Ricey</td> <td>Coarse</td> <td>do<td>Ricey</td><td>89</td><td>88</td><td>89</td><td>7</td><td>6</td><td>7</td></td>	Ricey	Coarse	do <td>Ricey</td> <td>89</td> <td>88</td> <td>89</td> <td>7</td> <td>6</td> <td>7</td>	Ricey	89	88	89	7	6	7	
Sept. 25-30	378	D	D	D	C	C	C	PY	GY	GY	GY	Coarse	Coarse	do <td>Coarse</td> <td>Coarse</td> <td>do<td>Coarse</td><td>102</td><td>93</td><td>93</td><td>6</td><td>5</td><td>6</td></td>	Coarse	Coarse	do <td>Coarse</td> <td>102</td> <td>93</td> <td>93</td> <td>6</td> <td>5</td> <td>6</td>	Coarse	102	93	93	6	5	6	
Oct. 25-30	458	E	E	E	D	D	D	PY	PY	PY	PY	Good	Good	do <td>Good</td> <td>Good</td> <td>do<td>Good</td><td>109</td><td>100</td><td>102</td><td>6</td><td>5</td><td>5</td></td>	Good	Good	do <td>Good</td> <td>109</td> <td>100</td> <td>102</td> <td>6</td> <td>5</td> <td>5</td>	Good	109	100	102	6	5	5	
Nov. 20-25	526	F	F	F	E	E	E	PY	PY	PY	PY	do	do <td>do<td>do</td><td>do<td>do<td>do</td><td>113</td><td>106</td><td>106</td><td>6</td><td>5</td><td>5</td></td></td></td>	do <td>do</td> <td>do<td>do<td>do</td><td>113</td><td>106</td><td>106</td><td>6</td><td>5</td><td>5</td></td></td>	do	do <td>do<td>do</td><td>113</td><td>106</td><td>106</td><td>6</td><td>5</td><td>5</td></td>	do <td>do</td> <td>113</td> <td>106</td> <td>106</td> <td>6</td> <td>5</td> <td>5</td>	do	113	106	106	6	5	5	
Dec. 18-23	593	F	F	F	F	F	F	PY	PY	PY	PY	do	do <td>do<td>do</td><td>do<td>do<td>do</td><td>114</td><td>110</td><td>116</td><td>7</td><td>6</td><td>6</td></td></td></td>	do <td>do</td> <td>do<td>do<td>do</td><td>114</td><td>110</td><td>116</td><td>7</td><td>6</td><td>6</td></td></td>	do	do <td>do<td>do</td><td>114</td><td>110</td><td>116</td><td>7</td><td>6</td><td>6</td></td>	do <td>do</td> <td>114</td> <td>110</td> <td>116</td> <td>7</td> <td>6</td> <td>6</td>	do	114	110	116	7	6	6	
Jan. 15-20	629	H	H	G	F	F	F	PY	PY	PY	PY	do	do <td>do<td>do</td><td>do<td>do<td>do</td><td>117</td><td>110</td><td>118</td><td>8</td><td>6</td><td>6</td></td></td></td>	do <td>do</td> <td>do<td>do<td>do</td><td>117</td><td>110</td><td>118</td><td>8</td><td>6</td><td>6</td></td></td>	do	do <td>do<td>do</td><td>117</td><td>110</td><td>118</td><td>8</td><td>6</td><td>6</td></td>	do <td>do</td> <td>117</td> <td>110</td> <td>118</td> <td>8</td> <td>6</td> <td>6</td>	do	117	110	118	8	6	6	
Feb. 12-17	633	H	H	G	G	G	G	TY	TY	TY	TY	do	do <td>do<td>do</td><td>do<td>do<td>do</td><td>116</td><td>113</td><td>118</td><td>7</td><td>5</td><td>6</td></td></td></td>	do <td>do</td> <td>do<td>do<td>do</td><td>116</td><td>113</td><td>118</td><td>7</td><td>5</td><td>6</td></td></td>	do	do <td>do<td>do</td><td>116</td><td>113</td><td>118</td><td>7</td><td>5</td><td>6</td></td>	do <td>do</td> <td>116</td> <td>113</td> <td>118</td> <td>7</td> <td>5</td> <td>6</td>	do	116	113	118	7	5	6	
Mar. 11-16	704	H	H	G	G	G	G	TY	TY	TY	TY	do	do <td>do<td>do</td><td>do<td>do<td>do</td><td>119</td><td>118</td><td>124</td><td>7</td><td>5</td><td>7</td></td></td></td>	do <td>do</td> <td>do<td>do<td>do</td><td>119</td><td>118</td><td>124</td><td>7</td><td>5</td><td>7</td></td></td>	do	do <td>do<td>do</td><td>119</td><td>118</td><td>124</td><td>7</td><td>5</td><td>7</td></td>	do <td>do</td> <td>119</td> <td>118</td> <td>124</td> <td>7</td> <td>5</td> <td>7</td>	do	119	118	124	7	5	7	
Apr. 8-13	683	H	G	F	F	F	G	TY	TY	TY	TY	do	do <td>do<td>do</td><td>do<td>do<td>do</td><td>113</td><td>119</td><td>125</td><td>7</td><td>6</td><td>7</td></td></td></td>	do <td>do</td> <td>do<td>do<td>do</td><td>113</td><td>119</td><td>125</td><td>7</td><td>6</td><td>7</td></td></td>	do	do <td>do<td>do</td><td>113</td><td>119</td><td>125</td><td>7</td><td>6</td><td>7</td></td>	do <td>do</td> <td>113</td> <td>119</td> <td>125</td> <td>7</td> <td>6</td> <td>7</td>	do	113	119	125	7	6	7	
May 6-11	738	H	G	F	F	F	G	TY	TY	TY	TY	do	do <td>do<td>do</td><td>do<td>do<td>do</td><td>119</td><td>122</td><td>129</td><td>8</td><td>7</td><td>7</td></td></td></td>	do <td>do</td> <td>do<td>do<td>do</td><td>119</td><td>122</td><td>129</td><td>8</td><td>7</td><td>7</td></td></td>	do	do <td>do<td>do</td><td>119</td><td>122</td><td>129</td><td>8</td><td>7</td><td>7</td></td>	do <td>do</td> <td>119</td> <td>122</td> <td>129</td> <td>8</td> <td>7</td> <td>7</td>	do	119	122	129	8	7	7	

Picking period	Juice per 100 grams of fruit ¹	Flavor ^{2,4}				Total ash ⁵			Ascorbic acid per milliliter ⁶			Active acidity ⁶													
		1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42		1942-43		1939-40		1940-41		1941-42		1942-43	
		Ml.	V acid	Acid	Tart	V acid	Acid	Tart	V acid	do	Tart	Pct.	Pct.	Pct.	Mg.	Mg.	Mg.	pH	pH	pH	pH	pH	pH	pH	
Aug. 25-Sept. 2	32	V acid	Acid	do	V acid	Acid	do	V acid	do	do	0.424	0.294	0.403	0.43	0.40	0.53	0.45	3.14	3.25	3.20	3.20	3.22			
Sept. 25-30	41	Acid	do	do	Acid	do	do	do	do	do	.344	.431	.373	.40	.38	.44	.44	3.45	3.15	3.20	3.08	3.08			
Oct. 25-30	44	P tart	Tart	do	Tart	do	do	Tart	do	do	.233	.294	.289	.39	.41	.42	.44	3.15	3.13	3.09	2.94	2.94			
Nov. 20-25	47	do	do	do	do	do	do	do	do	do	.252	.314	.252	.40	.39	.41	.42	3.11	3.13	3.07	2.96	2.96			
Dec. 18-23	50	do	do	do	do	do	do	do	do	do	.285	.284	.277	.38	.36	.37	.38	3.21	3.18	3.15	3.12	3.12			
Jan. 15-20	48	do	do	do	do	do	do	do	do	do				.35	.35	.35	.37	3.21	3.21	3.18	3.12	3.12			
Feb. 12-17	49	do	do	do	do	do	do	do	do	do				.33	.32	.35	.36	3.28	3.26	3.19	3.12	3.12			
Mar. 11-16	48	do	do	do	do	do	do	do	do	do				.34	.31	.30	.34	3.28	3.26	3.21	3.14	3.14			
Apr. 8-13	51	do	do	do	do	do	do	do	do	do				.35	.26	.30	.31	3.46	3.47	3.34	3.16	3.16			
May 6-11	50	P tart to S	do	do	do	do	do	do	do	do															

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.² GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.³ Each figure represents a mean of 25 determinations for 1 season.⁴ See U. S. Department of Agriculture color chart (pl. 4).⁵ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.⁶ Each figure represents a mean of duplicate determinations.

TABLE 30.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on sour orange rootstock at Palmetto, Fla., 1939-43—Continued

Picking period	Total solids ²				Total acid ³				Solids-acid ratio				Fruit below solids-acid ratio			
	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43
Aug. 25-Sept. 2	Pct. 8.47±0.09	Pct. 8.89±0.12	Pct. 11.10±0.10	Pct. 9.47	Pct. 1.61±0.02	Pct. 1.74±0.02	Pct. 1.92±0.03	Pct. 1.85	5.26	5.11	5.78	5.12	Pct. 100	Pct. 100	Pct. 96	Pct. 96
Sept. 25-30	9.38±0.06	9.08±0.06	10.59±0.07	9.77	1.38±0.02	1.60±0.02	1.69±0.02	1.57	6.80	5.83	6.27	6.22	48	96	68	68
Oct. 23-28	9.47±0.07	10.39±0.09	10.45±0.09	11.16	1.31±0.02	1.68±0.02	1.44±0.03	1.73	7.23	6.18	7.26	6.45	20	56	8	8
Nov. 20-25	10.21±0.07	11.41±0.07	10.79±0.12	11.33	1.32±0.02	1.64±0.03	1.43±0.02	1.71	7.73	6.96	7.55	6.63	4	16	4	4
Dec. 18-23	10.51±0.09	11.36±0.08	11.05±0.07	11.24	1.32±0.02	1.58±0.03	1.32±0.02	1.58	7.96	7.19	7.78	7.11	4	4	0	0
Jan. 15-20	10.02±0.12	11.89±0.13	11.46±0.08	11.13	1.34±0.02	1.57±0.03	1.31±0.02	1.54	7.48	7.57	8.05	7.36	12	0	0	0
Feb. 12-17	11.08±0.10	11.52±0.12	11.31±0.08	11.33	1.29±0.03	1.50±0.03	1.29±0.02	1.54	8.69	7.68	8.75	7.86	4	4	0	0
Mar. 11-16	11.02±0.14	11.85±0.10	11.39±0.11	11.23	1.27±0.02	1.49±0.02	1.24±0.02	1.47	9.23	7.95	9.19	7.91	0	0	0	0
Apr. 8-13	10.61±0.14	11.30±0.13	11.36±0.11	10.83	1.15±0.02	1.36±0.02	1.20±0.02	1.32	8.32	8.32	9.47	7.91	0	0	0	0
May 6-11	10.63±0.13	11.92±0.11	11.07±0.12	11.23	1.02±0.03	1.36±0.02	1.05±0.02	1.35	10.42	9.40	10.54	8.32	0	0	0	0

² Each figure or description represents a mean of 25 determinations for 1 season.TABLE 31.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on sour orange rootstock at Vero Beach, Fla., 1939-43

Picking period	Weight per fruit ¹	Rind color ^{2 3}				Flesh color ^{2 4}				Flesh texture ^{2 5}				Diameter of fruit ²				Rind thickness ²			
		1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43	1939-40	1940-41	1941-42	1942-43
Aug. 25-Sept. 2	Gm. 320	D	C	C	B	PY	GY	GY	GY	Coarse	Ricey	Ricey	Ricey	Mm. 99	Mm. 94	Mm. 97	Mm. 91	Mm. 6	Mm. 7	Mm. 5	Mm. 5
Sept. 25-30	383	E	D	D	C	PY	GY	GY	GY	do	do	do	Coarse	105	97	97	97	6	6	6	5
Oct. 23-28	464	F	E	D	C	PY	GY	GY	GY	Good	Good	Good	Good	111	102	103	103	6	6	5	5
Nov. 20-25	525	F	F	F	E	PY	TY	TY	TY	do	do	do	do	115	106	107	107	6	5	6	6
Dec. 18-23	581	G	F	F	G	TY	TY	TY	TY	do	do	do	do	113	109	113	115	7	6	6	6
Jan. 15-20	623	G	G	F	G	TY	TY	TY	TY	do	do	do	do	115	113	119	119	8	6	6	5
Feb. 12-17	669	G	G	G	G	TY	TY	TY	TY	F (28)	do	do	do	115	116	126	126	7	6	5	5
Mar. 11-16	668	G	G	F	G	TY	TY	TY	TY	F (8)	do	do	do	114	116	125	125	8	6	5	5
Apr. 8-13	734	G	G	F	G	TY	TY	TY	TY	F (21)	do	do	do	121	122	131	131	8	7	7	8
May 6-11	722	G	F	F	G	TY	TY	TY	TY	F (12)	do	do	do	113	-119	131	131	7	7	7	8

¹ Each figure represents a mean of 100 determinations for 1939-40, 1940-41, 1941-42, and 1942-43.² Each figure or description represents a mean of 25 determinations for 1 season.

See U. S. Department of Agriculture color chart (pl. 4).

³ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁴ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.⁵ Nearby grove under same management and cultural practices as the one used in 1939-42.

Picking period	Flavor ^{2 4}				Total ash ⁸		Ascorbic acid per milliliter ^{7 8}		Active acidity ⁸	
	1939-40		1940-41		1941-42		1939-40		1940-41	
	V acid	V acid	V acid	V acid	Pct.	Pct.	Mg.	Mg.	pH	pH
Aug. 25-Sept. 2	30	30	30	30	0.300	0.334	0.46	0.49	3.13	3.22
Sept. 25-30	38	38	38	38	0.271	0.303	0.42	0.45	3.10	3.10
Oct. 23-28	42	42	42	42	0.284	0.316	0.40	0.44	3.08	3.11
Nov. 20-25	46	46	46	46	0.335	0.333	0.40	0.46	3.11	3.12
Dec. 18-23	47	47	47	47	0.276	0.365	0.42	0.43	3.15	3.15
Jan. 15-20	47	47	47	47	0.276	0.365	0.42	0.43	3.11	3.19
Feb. 12-17	46	46	46	46	0.276	0.365	0.42	0.43	3.14	3.20
Mar. 11-16	47	47	47	47	0.276	0.365	0.40	0.40	3.11	3.22
Apr. 8-13	49	49	49	49	0.276	0.365	0.41	0.40	3.15	3.23
May 6-11	47	47	47	47	0.276	0.365	0.40	0.40	3.28	3.29
									3.32	3.32

Picking period	Total solids ²				Total acid ²		Solids-acid ratio		Fruit below solids-acid ratio	
	1939-40		1940-41		1941-42		1939-40		1940-41	
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Aug. 25-Sept. 2	8.81±0.07	8.39±0.06	9.20±0.08	9.67	1.89±0.02	1.88±0.02	5.47	4.44	100	100
Sept. 25-30	9.05±0.07	8.54±0.09	9.67±0.11	9.84	1.81±0.03	1.75±0.02	6.33	4.72	88	100
Oct. 23-28	9.28±0.09	9.44±0.07	9.91±0.09	10.26	1.73±0.02	1.63±0.03	6.93	5.46	100	96
Nov. 20-25	9.69±0.08	10.04±0.08	10.24±0.13	10.59	1.69±0.02	1.58±0.02	7.29	6.08	44	100
Dec. 18-23	10.46±0.08	10.28±0.09	10.41±0.12	11.19	1.33±0.02	1.46±0.03	7.86	6.20	20	76
Jan. 15-20	10.52±0.13	10.06±0.10	11.13±0.12	11.19	1.37±0.02	1.28±0.03	7.68	6.23	0	68
Feb. 12-17	10.41±0.10	10.32±0.14	11.45±0.11	11.88	1.20±0.02	1.24±0.02	8.70	6.53	4	48
Mar. 11-16	10.69±0.12	10.57±0.13	12.03±0.22	11.49	1.54±0.02	1.24±0.02	8.07	6.70	0	32
Apr. 8-13	9.96±0.15	10.54±0.11	11.08±0.13	11.45	1.31±0.02	1.13±0.02	8.16	6.82	0	24
May 6-11	9.96±0.23	10.33±0.12	11.04±0.11	11.30	1.12±0.03	1.08±0.03	8.23	7.87	0	8
							8.89	8.33	0	0

² Each figure or description represents a mean of 25 determinations for 1 season.⁴ GY, greenish yellow; PY, pale yellow; TY, tannish yellow; V, very; P, pleasantly; S, sweet; W, watery.⁷ Each figure represents a mean of 75 determinations for 3 seasons; juice extracted by means of an electric reamer.⁸ Each figure represents a mean of duplicate determinations.⁶ Nearly grove under same management and cultural practices as the one used in 1939-42.

TABLE 32.—Seasonal changes in physical characters and chemical constituents of Foster (pink) grapefruit on sour orange rootstock at Bradenton, Fla., 1939-41

Picking period	Weight per fruit ¹	Rind color ^{2,3}		Flesh color ^{2,4}		Flesh texture ^{2,5}		Diameter of fruit ²		Rind thickness ²		Juice per 100 grams of fruit ⁶		Flavor ^{2,4}	
		1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41
		Percent	Percent	Mq.	Mq.	pH	pH	Mm.	Mm.	Ml.	Ml.	Ml.	Ml.	Acid.	Do.
Aug. 25-Sept. 2.	336	D	D	P	PG	Riccy	Riccy	97	91	7	6	29	29	V acid.	Acid.
Sept. 25-30	383	D	E	P	P	Coarse	Coarse	102	91	7	5	33	33	Acid.	Do.
Oct. 23-28	460	E	F	P	P	Good	Good	107	98	6	5	47	47	Tart.	Tart.
Nov. 20-25	578	F	F	P	P	do.	do.	116	106	5	5	51	51	P tart.	Do.
Dec. 18-23	618	F	F	P	P	do.	do.	118	111	5	5	57	57	do.	Do.
Jan. 15-20	637	F	F	P	P	do.	do.	120	111	7	5	51	51	P tart to S.	Do.
Feb. 12-17	719	F	F	P	P	F (12)	F (12)	126	116	7	5	53	53	do.	Do.
Mar. 11-16	668	F	F	Pale P	Pale P	do.	do.	126	119	7	6	50	50	do.	Do.
Apr. 8-13	757	F	F	do.	do.	do.	do.	119	119	7	6	50	50	do.	Do.
May 6-11	714	F	F	do.	do.	do.	do.	122	122	7	6	53	53	do.	Do.

Picking period	Total ash ⁷		Ascorbic acid per milliliter ⁷		Active acidity ⁷		Total solids ²		Total acid ²		Solids-acid ratio		Fruit below solids-acid ratio	
	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41	1939-40	1940-41
	Percent	Percent	Mq.	Mq.	pH	pH	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Aug. 25-Sept. 2.	0.330	0.336	0.54	0.57	3.17	3.22	8.58±0.06	9.44±0.10	1.60±0.02	1.93±0.03	5.36	4.89	100	100
Sept. 25-30	—	—	—	—	3.15	3.20	9.15±0.08	10.09±0.12	1.35±0.01	1.86±0.04	6.78	5.42	60	100
Oct. 23-28	.315	.369	.49	.56	3.10	3.12	9.10±0.07	10.63±0.15	1.19±0.02	1.66±0.03	7.65	6.40	12	72
Nov. 20-25	—	—	.44	.50	3.20	3.20	9.82±0.08	11.02±0.09	1.19±0.02	1.56±0.03	8.25	7.06	0	16
Dec. 18-23	.242	.286	.45	.49	3.17	3.13	9.71±0.12	10.49±0.11	1.17±0.02	1.50±0.02	8.30	6.99	0	0
Jan. 15-20	—	—	.46	.46	3.21	3.20	10.61±0.13	10.66±0.16	1.24±0.03	1.48±0.03	8.56	7.20	0	0
Feb. 12-17	.222	.304	.42	.44	3.19	3.07	10.34±0.14	10.96±0.14	1.20±0.03	1.42±0.02	8.62	7.72	0	0
Mar. 11-16	—	—	.39	.40	3.19	3.24	10.08±0.14	11.78±0.20	1.19±0.03	1.37±0.02	8.47	7.87	0	0
Apr. 8-13	—	.307	—	.40	3.25	3.25	—	11.21±0.20	—	1.28±0.03	—	8.76	0	0
May 6-11	—	—	—	.36	3.38	3.38	—	11.06±0.15	—	1.14±0.05	—	9.70	—	—

¹ Each figure represents a mean of 50 determinations for 1939-40 and 1940-41.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (p. 4).⁴ P, pink; PG, pinkish green; V, very; F, pleasant; S, sweet; W, watery.⁵ F, freezing damage. The number in parentheses after F represents the percentage of

fruit in the sample showing freezing damage.

⁶ Each figure represents a mean of 25 determinations for 1 season; juice extracted by means of an electric reamer.⁷ Each figure represents a mean of duplicate determinations.

TABLE 33.—Seasonal changes in physical characters and chemical constituents of Thompson (pink) grapefruit on sour orange rootstock at Bradenton, Fla., 1941-43

Picking period	Weight per fruit ¹	Rind color ^{2,3}		Flesh color ^{2,4}		Flesh texture ²		Diameter of fruit ²	Rind thickness ²	Juice per 100 grains of fruit ⁵	Flavor ^{2,4}	
		1941-42	1942-43	1941-42	1942-43	1941-42	1942-43				1941-42	1942-43
		B	B	YP	PG	Ricey	Ricey				V acid	V acid.
Aug. 25-Sept. 2	187	C	C	YP	Pale P	Coarse	Coarse	81	8	34	do.	Do.
Sept. 25-30	280	C	D	P	P	do.	do.	87	6	39	Tart.	Acid.
Oct. 23-30	343	E	E	P	P	do.	do.	95	6	45	do.	Tart.
Nov. 20-25	428	F	F	P	P	Good	Good	104	5	47	do.	P tart.
Dec. 18-23	452	F	F	Pale P	P	do.	do.	111	5	51	do.	Do.
Jan. 15-20	348	F	H	do.	P	do.	do.	117	6	49	P tart.	P tart to S.
Feb. 12-17	356	F	H	do.	P	do.	do.	114	5	51	do.	Do.
Mar. 11-16	514	F	G	do.	Pale P	do.	do.	123	6	50	do.	Do.
Apr. 8-13	512	---	G	do.	do.	do.	do.	---	---	55	do.	Do.
May 6-11	329	---	G	---	do.	do.	do.	---	---	56	---	Do.

Picking period	Total ash ⁶	Ascorbic acid per milliliter ⁶		Active acidity ⁶		Total solids ²		Total acid ²		Solids-acid ratio		Fruit below solids-acid ratio ¹
		1941-42	1942-43	1941-42	1942-43	1941-42	1942-43	1941-42	1942-43	1941-42	1942-43	
		Percent	Mg.	pH	pH	Percent	Percent	Percent	Percent	Percent	Percent	
Aug. 25-Sept. 2	0.392	0.62	0.54	3.19	3.03	9.77±0.15	10.26	1.79±0.02	1.73	5.46	5.93	96
Sept. 25-30	.53	.53	.44	3.05	2.86	9.32±0.06	9.22	1.64±0.01	1.39	5.68	6.63	160
Oct. 23-28	.267	.50	.42	3.02	2.86	9.36±0.05	9.78	1.36±0.02	1.39	6.88	7.04	152
Nov. 20-25	.189	.46	.41	2.98	3.03	9.17±0.07	10.22	1.29±0.02	1.23	7.11	8.31	20
Dec. 18-23	.39	.39	.40	2.99	2.99	9.17±0.07	10.29	1.22±0.02	1.26	7.52	8.17	12
Jan. 15-20	.37	.36	.39	3.08	3.09	9.55±0.09	9.78	1.13±0.02	1.07	8.45	9.14	0
Feb. 12-17	.172	.37	.40	3.09	3.15	9.56±0.08	10.05	1.08±0.02	1.00	8.85	10.03	0
Mar. 11-16	---	.35	.34	3.12	3.32	8.97±0.07	9.90	1.04±0.02	1.10	8.63	9.06	0
Apr. 8-13	---	---	.35	---	---	---	8.87	---	.84	---	11.05	---
May 6-11	---	---	.35	---	3.50	---	---	---	.70	---	12.67	---

¹ Each figure represents a mean of 50 determinations for 1941-42 and 1942-43.² Each figure or description represents a mean of 25 determinations for 1 season.³ See U. S. Department of Agriculture color chart (pl. 4).⁴ YP, yellow pink; P, pink; PG, pinkish green; V, very; P, pleasantly; S, sweet; W, watery.⁵ Each figure represents a mean of 50 determinations for 2 seasons; juice extracted by means of an electric reamer.⁶ Each figure represents a mean of duplicate determinations.

TABLE 34.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Lake Hamilton, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]¹

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter	Active acid ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
Unsprayed: 1942	Gm.				Ml.	Percent	V acid		Ma	pH	Percent	Percent	
	261	B	GY	Ribey	31	32	do	20	0.48	3.01	1.82	9.96	5.47
	356	C	PY	do	31	32	do	35	.44	3.00	1.55	9.67	6.24
	371	D	PY	Coarse	44	46	do	58	.42	3.00	1.61	9.87	6.13
	402	E	PY	Good	40	42	Tart	67	.42	3.05	1.55	10.48	6.76
	448	F	TY	do	40	42	do	65	.41	3.04	1.45	10.56	7.28
Unsprayed: 1943													
	476	G	TY	do	45	47	P tart.	73	.39	3.03	1.40	9.84	7.03
	504	G	TY	do	46	48	do	77	.39	3.06	1.35	9.92	7.35
	567	G	TY	do	46	47	P tart to S	81	.38	3.28	1.17	9.54	8.15
	619	G	TY	do	47	48	do	80	.35	3.36	1.01	9.37	9.18
	612	G	TY	do	48	49	do	80	.34	3.39	.93	8.59	9.24
Sprayed: 1942													
	280	A	GY	Ribey	31	32	V acid	20	.46	3.00	1.88	9.76	5.19
	340	C	PY	do	35	36	do	29	.45	2.99	1.49	9.33	6.26
	350	D	PY	Coarse	43	44	Tart	63	.44	3.02	1.50	10.00	6.67
	401	F	TY	Good	43	44	do	68	.45	3.08	1.44	10.51	7.30
	453	F	TY	do	42	43	P tart.	70	.42	3.07	1.38	10.53	7.63
Sprayed: 1943													
	470	F	TY	do	44	46	do	74	.41	3.07	1.29	9.94	7.71
	488	G	TY	do	46	47	do	78	.41	3.20	1.20	10.14	8.45
	543	G	TY	do	45	47	P tart to S	81	.39	3.20	1.07	10.04	9.38
	586	G	TY	do	48	50	do	81	.36	3.23	.94	9.27	9.86
	580	G	TY	do	49	50	do	86	.36	3.34	.83	8.59	10.35

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 35.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Davenport, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio		
							Arbitrary standard	Numeri- cal rating							
Unsprayed: 1942	Gm.				Ml.	Percent	V acid		Mg.	pH	Percent				
	Aug. 25-Sept. 2	257	A	GY	Ricey	35	35	do	20	0.50	1.88	8.92	4.74		
	Sept. 25-30	308	B	PY	do	35	28	do	28	.45	2.97	8.98	5.99		
	Oct. 23-28	400	D	PY	do	44	45	Acid	57	.41	2.95	9.22	5.95		
	Nov. 20-25	411	E	TY	Coarse	44	46	Tart	60	.41	2.97	9.78	6.35		
	Dec. 18-23	464	F	TY	Good	44	46	do	65	.40	2.97	1.47	9.59	6.52	
1943															
	Jan. 15-20	489	F	TY	do	46	47	do	66	.39	3.08	1.44	9.37	6.51	
	Feb. 12-17	552	G	TY	do	47	49	P tart	76	.38	3.07	1.38	9.27	6.72	
	Mar. 11-16	544	G	TY	do	48	49	do	78	.37	3.04	1.30	9.30	7.10	
	Apr. 8-13	577	G	TY	do	51	53	P tart to S	80	.35	3.10	1.25	9.27	7.42	
1942															
	May 6-11	555	G	TY	do	51	52	do	83	.35	3.12	1.12	8.75	7.81	
	Sprayed: 1942														
		Aug. 25-Sept. 2	281	B	GY	Ricey	31	32	V acid	20	.52	3.05	1.59	9.27	5.83
		Sept. 25-30	313	B	PY	do	38	39	do	36	.45	3.06	1.30	9.33	7.18
Oct. 23-28		388	D	PY	do	43	44	Tart	62	.42	3.02	1.26	9.37	7.44	
Nov. 20-25		439	E	TY	Coarse	45	47	P tart	73	.42	3.15	1.22	9.83	8.06	
1943															
	Dec. 18-23	406	F	TY	Good	44	46	do	76	.42	3.15	1.16	10.14	8.74	
	1943														
		Jan. 15-20	488	F	TY	do	48	49	do	77	.40	3.22	1.08	9.75	9.03
		Feb. 12-17	534	G	TY	do	48	49	P tart to S	82	.38	3.22	1.04	9.77	9.39
Mar. 11-16		547	G	TY	do	48	50	do	84	.38	3.29	.92	9.65	10.49	
Apr. 8-13		582	G	TY	do	49	51	do	85	.36	3.44	.82	9.47	11.55	
May 6-11	563	G	TY	do	54	55	do	86	.36	3.56	.73	9.40	12.88		

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.

TABLE 36.—*Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Minneola, Fla., 1942-43*

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acid per acidity ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating				
Unsprayed: 1942	Gm.				Ml.	Percent			Mg.	pH	Percent	
	272	A	PY	Ricey.....	34	34	V acid.....	20	0.38	2.98	1.66	4.98
	366	B	PY	do.....	36	37	do.....	35	.38	3.04	1.31	6.63
	405	D	PY	do.....	45	44	Acid.....	53	.36	3.01	1.43	6.18
	417	E	PY	Good.....	45	46	Tart.....	61	.35	3.00	1.41	6.33
	515	H	TY	do.....	45	46	do.....	64	.32	3.06	1.43	6.46
1943												
	506	H	TY	do.....	46	48	do.....	69	.34	3.08	1.35	7.05
	546	G	TY	do.....	47	48	P tart.....	77	.31	3.12	1.16	7.47
	587	C	TY	do.....	46	47	P tart to S.....	81	.30	3.13	1.13	7.84
	586	C	TY	do.....	48	50	do.....	81	.30	3.16	1.03	8.25
	595	F	TY	do.....	48	50	do.....	85	.29	3.36	.88	8.05
1942												
	274	A	GY	Ricey.....	34	34	V acid.....	20	.43	3.04	1.49	5.56
	377	B	GY	do.....	36	37	do.....	39	.36	3.09	1.26	6.56
	403	D	PY	do.....	44	46	Acid.....	59	.36	3.08	1.20	7.39
	432	F	PY	Good.....	45	46	Tart.....	67	.36	3.13	1.17	7.79
	408	F	TY	do.....	45	46	do.....	67	.34	3.13	1.19	7.81
1943												
	472	F	TY	do.....	45	46	P tart.....	70	.34	3.27	1.03	9.00
	555	G	TY	do.....	47	48	P tart to S.....	80	.33	3.27	.98	9.10
	572	G	TY	do.....	46	47	do.....	82	.32	3.37	.98	8.40
	571	G	TY	do.....	48	49	do.....	83	.30	3.39	.81	8.20
	614	F	TY	do.....	48	49	do.....	84	.29	3.39	.71	11.34

¹ V, very; P, pleasantly; S, sweet.

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

¹ See U. S. Department of Agriculture color chart (pl. 4).

TABLE 37.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Howey In The Hills, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
							Arbitrary standard	Numerical rating					
1942													
Unsprayed:													
Aug. 25-Sept. 2	250	A	GY	Riccy	37	37	V acid	20	Mg. 0.42	pH 3.10	Percent 1.80	Percent 8.26	4.59
Sept. 25-30	355	C	PY	do	37	39	do	36	.38	3.00	1.42	8.33	5.87
Oct. 23-28	386	D	PY	do	47	48	Acid	52	.38	2.92	1.48	8.81	5.95
Nov. 20-25	370	F	PY	Coarse	47	48	Tart	61	.38	2.98	1.71	10.15	5.94
Dec. 18-23	470	F	TY	do	45	46	Acid	57	.38	2.99	1.56	10.07	6.46
1943													
Jan. 15-20	503	G	TY	Good	46	47	Tart	61	.34	3.03	1.44	9.45	6.56
Feb. 12-17	568	G	TY	do	48	49	P tart	77	.33	3.09	1.27	9.30	7.32
Mar. 11-16	603	G	TY	do	51	52	P tart to S	82	.32	3.12	1.17	8.83	7.55
Apr. 8-13	646	G	TY	do	52	53	do	81	.30	3.14	1.08	8.17	7.56
May 6-11	648	F	TY	do	52	54	do	81	.25	3.35	.89	7.90	8.88
1942													
Sprayed:													
Aug. 25-Sept. 2	228	A	GY	Riccy	37	38	V acid	20	.44	3.04	1.64	8.26	5.04
Sept. 25-30	342	C	PY	do	38	40	do	30	.37	3.04	1.23	8.33	6.77
Oct. 23-28	375	D	PY	do	45	46	Acid	52	.38	3.08	1.36	9.24	6.79
Nov. 20-25	370	F	PY	Coarse	45	47	Tart	65	.41	3.08	1.53	10.08	6.98
Dec. 18-23	474	F	TY	do	46	48	do	64	.37	3.13	1.34	9.84	7.34
1943													
Jan. 15-20	470	G	TY	Good	45	46	P tart	72	.34	3.18	1.25	9.68	7.74
Feb. 12-17	554	G	TY	do	46	48	do	79	.32	3.16	1.15	9.30	8.09
Mar. 11-16	554	G	TY	do	48	49	P tart to S	84	.31	3.21	1.06	8.93	8.42
Apr. 8-13	629	G	TY	do	49	50	do	82	.29	3.28	.95	8.85	9.32
May 6-11	620	F	TY	do	52	53	do	82	.24	3.57	.78	8.10	10.38

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.

TABLE 38.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Fort Pierce, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
1942 Unsprayed: Aug. 25-Sept. 2 Sept. 25-30 Oct. 23-28 Nov. 20-25 Dec. 18-23	Gm.				ML	Percent	V acid	20	Mg.	pH	Percent	Percent	
	208	B	GY	Riccy	24	24	do	26	0.36	3.05	1.77	8.28	5.24
	352	C	GY	do	31	32	do	47	.45	3.08	1.51	8.23	5.72
	333	D	PY	Coarse	46	47	Acid	55	.44	2.97	1.49	8.92	5.92
	421	E	TY	do	48	49	do	58	.39	3.02	1.39	8.87	6.38
1943 Jan. 15-20 Feb. 12-17 Mar. 11-16 Apr. 8-13 May 6-11	475	F	TY	Good	49	50	do		.37	2.95	1.30	8.92	6.86
	488	F	TY	do	50	51	Tart	69	.37	2.95	1.30	8.83	6.79
	582	G	TY	do	52	53	P tart	76	.37	3.02	1.24	8.80	7.10
	590	G	TY	do	53	55	do	79	.36	3.08	1.22	8.91	7.30
	575	G	TY	do	53	55	P tart to S	85	.36	3.08	1.18	9.17	7.77
1942 Sprayed: Aug. 25-Sept. 2 Sept. 25-30 Oct. 23-28 Nov. 20-25 Dec. 18-23	387	F	TY	do	55	57	do	87	.32	3.07	1.07	9.10	8.50
	218	B	GY	Riccy	28	29	V acid	20	.59	3.02	1.71	8.87	5.19
	324	C	GY	Coarse	30	31	do	25	.47	3.05	1.45	8.73	6.02
	334	C	PY	do	45	47	Acid	48	.42	3.02	1.43	8.62	6.17
	403	E	TY	Good	48	48	do	55	.41	3.03	1.33	9.04	6.83
1943 Jan. 15-20 Feb. 12-17 Mar. 11-16 Apr. 8-13 May 6-11	485	F	TY	do	48	49	Tart	62	.37	3.02	1.28	8.97	7.01
	506	G	TY	do	48	49	do	69	.38	3.02	1.21	8.80	7.27
	564	G	TY	do	52	53	P tart	77	.38	3.06	1.20	8.75	7.59
	571	G	TY	do	51	52	P tart to S	84	.38	3.09	1.17	8.90	7.61
	566	G	TY	do	52	53	do	85	.38	3.14	1.08	8.17	7.56
	683	F	TY	do	54	55	do	87	.33	3.28	1.03	8.90	8.64

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 39.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Clearwater, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating				
Unsprayed: 1942	Gm.	A	GY	Ricey	Ml.	Percent	V acid	20	Mg.	pH	Percent	
	190	C	PY	Coarse	31	32	do	37	0.98	2.95	10.91	4.89
	256	E	TY	do	35	36	do	37	.48	2.92	1.68	6.23
	293	E	TY	Good	42	43	do	56	.47	2.99	1.81	11.23
	354	E	TY	do	43	45	do	59	.44	3.04	1.72	6.50
	366	F	TY	do	45	46	Tart	62	.43	3.11	1.64	6.87
1943		F	TY	do	45	47	P tart	72	.42	3.08	1.52	7.36
	424	G	TY	do	47	49	do	79	.40	3.02	1.48	7.60
	448	G	TY	do	47	48	P tart to S	83	.41	3.18	1.44	7.90
	469	G	TY	do	47	49	do	87	.38	3.12	1.35	8.30
	468	G	TY	do	47	49	do	87	.37	3.30	1.21	9.36
	454	G	TY	do	48	50	do	89				
Sprayed: 1942		A	GY	Ricey	34	35	V acid	20	.57	3.00	2.03	5.20
	202	C	PY	do	36	37	do	37	.47	2.98	1.53	6.48
	292	E	PY	Coarse	42	43	do	59	.47	2.98	1.61	6.94
	312	E	TY	do	45	47	Tart	67	.43	2.98	1.54	7.36
	356	E	TY	Good	45	47	do	68	.41	2.98	1.37	8.23
	386	F	TY	do	46	47	do					
1943		F	TY	do	46	49	P tart	75	.41	3.12	1.25	10.79
	459	G	TY	do	47	48	P tart to S	83	.41	3.14	1.27	8.88
	437	G	TY	do	45	46	do	86	.40	3.17	1.24	9.13
	471	G	TY	do	47	49	do	90	.38	3.29	1.08	10.20
	491	G	TY	do	47	49	do	86	.34	3.47	.89	11.61
	419	G	TY	do	48	50	do					

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tawnyish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.

TABLE 40.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Bradenton, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter	Active acid per acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
							Arbitrary standard	Numerical rating					
1942 Unsprayed: Aug. 25-Sept. 2 Sept. 25-30 Oct. 25-28 Nov. 20-23 Dec. 18-23	Gm.				ML	Percent	V acid	20	Ma.	pH	Percent	Percent	
	290	A	GY	Ricey	36	37	do	20	0.48	3.04	1.85	8.87	4.79
	300	B	PY	Coarse	42	43	do	28	.39	3.00	1.41	9.02	6.40
	358	D	PY	do	47	49	Acid	52	.38	3.00	1.47	9.42	6.41
	418	E	TY	Good	50	53	do	56	.37	2.97	1.29	9.18	7.12
	486	F	TY	do	51	53	Tart	65	.37	2.98	1.28	9.29	7.26
1943 Jan. 15-20 Feb. 12-17 Mar. 1-16 Apr. 8-13 May 6-11							P tart	75	.35	2.98	1.23	9.03	7.34
	528	F	TY	do	53	54	do	79	.34	3.04	1.17	9.23	7.89
	546	H	TY	do	55	56	do	81	.33	3.07	1.15	9.01	7.83
	527	G	TY	do	57	59	P tart to S	85	.32	3.10	1.09	9.13	8.38
	536	G	TY	do	57	58	do	87	.32	3.22	.97	8.37	8.63
	600	G	TY	do	57		do						
1943 Sprayed: Aug. 25-Sept. 2 Sept. 25-30 Oct. 25-28 Nov. 20-25 Dec. 18-23							V acid	20	.52	3.04	1.77	8.92	5.04
	211	A	GY	Ricey	33	34	do	27	.42	3.02	1.34	8.90	6.64
	272	B	PY	Coarse	49	50	do	45	.41	3.04	1.25	9.37	7.50
	344	D	PY	do	47	48	Acid	58	.40	3.10	1.11	9.23	8.32
	410	E	TY	Good	50	53	do	69	.37	3.14	1.03	9.19	8.92
	510	F	TY	do	49	50	Tart						
1943 Jan. 15-20 Feb. 12-17 Mar. 11-16 Apr. 8-13 May 6-11							P tart to S	80	.36	3.28	.97	9.03	9.31
	503	F	TY	do	53	55	do	82	.35	3.21	.97	9.03	9.31
	523	H	TY	do	56	57	do	83	.34	3.33	.81	9.03	11.15
	530	G	TY	do	55	57	do	87	.33	3.38	.78	9.03	11.58
	539	G	TY	do	56	59	do	87	.33	3.33	.66	8.47	12.83
	619	G	TY	do	55	57	do	88	.33	3.47			

³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 41.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Windermere, Fla., 1939-40

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1939; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Bind color ¹	Flesh color ²	Flesh texture ³	Juice per 100 grams of fruit	Flavor (arbitrary standard) ⁴	Ascorbic acid per milliliter ⁵	Active acidity ⁵	Total acid ⁵	Total solids ⁵	Solids-acid ratio
1939											
Unsprayed:	Gm.				Ml.		Mg.	pH	Percent	Percent	
Aug. 25-Sept. 2	320	C	GY	Ricey	34	V acid	0.46	3.07	1.54	7.69	4.99
Sept. 25-30	367	D	PY	Coarse	39	Acid	.43	3.05	1.32	7.88	5.97
Oct. 23-28	469	E	PY	do.	36	do.	.39	3.10	1.13	8.04	7.12
Nov. 20-25	509	F	PY	Good	38	P tart, W	.37	3.07	1.15	7.69	6.69
Dec. 18-23	527	F	PY	do.	39	do.	.39	3.07	1.17	7.82	6.68
1940											
Jan. 15-20	587	F	TY	do.	40	do.	.32	3.20	1.24	8.62	6.95
Feb. 12-17	613	F	TY	F (12)	40	do.	.34	3.17	1.22	8.48	6.95
Mar. 11-16	598	G	TY	F (12)	38	do.	.31	3.20	1.21	8.65	7.15
Apr. 8-13	578	G	TY	F (32)	40	do.	.33	3.27	1.30	8.71	6.70
May 6-11	633	G	TY	F (32)	38	do.	.29	3.32	1.01	7.91	7.83
1939											
Sprayed:											
Aug. 25-Sept 2	308	D	GY	Ricey	32	V acid	.48	3.15	1.48	7.91	5.34
Sept. 25-30	354	D	PY	Coarse	37	Acid	.45	3.13	1.27	8.39	6.61
Oct. 23-28	437	E	PY	do.	36	do.	.44	3.18	1.08	8.37	7.75
Nov. 20-25	515	F	PY	Good	27	P tart, W	.38	3.19	1.08	8.03	7.46
Dec. 18-23	507	F	PY	do.	38	do.	.42	3.19	1.11	8.28	7.46
1940											
Jan. 15-20	544	F	TY	do.	38	do.	.41	3.27	1.05	8.45	8.05
Feb. 12-17	556	G	TY	F (12)	38	do.	.39	3.23	1.04	8.31	7.99
Mar. 11-16	593	G	TY	F (32)	37	do.	.37	3.30	.97	7.97	8.22
Apr. 8-13	565	G	TY	F (12)	38	do.	.40	3.30	.90	7.75	8.61
May 6-11	582	G	TY	F (12)	37	do.	.35	3.41	.82	7.34	8.95

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ F, freezing damage. The number in parentheses after F represents the percentage of fruit in the sample showing freezing damage.⁴ V, very; P, pleasantly; S, sweet; W, watery.⁵ Each figure represents a mean of duplicate determinations.

TABLE 42.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Windermere, Fla., 1940-41

[Sprayed with lead arsenate at the rate of 1 or 2 pounds to 100 gallons of water in July 1940; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Flavor (arbitrary standard) ³	Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
1940											
Unsprayed:											
Aug. 25-Sept. 2	305	C	PY	Ricey	36	Acid.	0.49	pH 3.17	Percent 1.56	Percent 8.16	5.23
Sept. 25-30	360	D	PY	Coarse	45	do.	0.48	3.10	1.46	8.73	5.78
Oct. 23-28	390	E	TY	do.	49	Tart.	0.47	3.10	1.38	8.72	6.92
Nov. 20-25	455	F	TY	Good	49	do.	0.45	3.08	1.41	8.71	8.25
Dec. 18-23	460	F	TY	do.	52	P tart, W	0.45	3.09	1.36	8.77	6.45
1941											
Jan. 15-20	496	F	TY	do.	50	do.	0.43	3.16	1.27	8.44	6.65
Feb. 12-17	500	G	TY	do.	49	do.	0.40	3.19	1.21	8.09	6.69
Mar. 11-16	408	G	TY	do.	51	do.	0.41	3.23	1.18	8.31	7.04
Apr. 8-13	328	G	TY	do.	48	do.	0.42	3.21	1.17	8.67	7.41
May 6-11	498	G	TY	do.	47	do.	0.40	3.27	1.14	8.51	7.46
1940											
Sprayed (1 pound to 100 gallons):											
Aug. 25-Sept. 2	309	B	GY	Ricey	36	Tart.	0.48	3.20	1.46	8.23	5.64
Sept. 25-30	371	D	TY	Coarse	47	do.	0.44	3.15	1.37	8.63	6.30
Oct. 23-28	366	E	TY	do.	49	do.	0.45	3.12	1.37	8.84	6.45
Nov. 20-25	476	F	TY	Good	49	do.	0.42	3.18	1.27	8.87	6.98
Dec. 18-23	467	F	TY	do.	50	P tart, W	0.44	3.15	1.25	9.03	7.22
1941											
Jan. 15-20	590	F	TY	do.	49	do.	0.40	3.24	1.17	8.84	7.56
Feb. 12-17	533	G	TY	do.	49	do.	0.37	3.24	1.10	8.61	7.83
Mar. 11-16	566	H	TY	do.	49	P tart to S, W	0.35	3.24	1.04	8.54	8.21
Apr. 8-13	576	H	TY	do.	49	do.	0.35	3.28	1.01	8.25	8.17
May 6-11	568	H	TY	do.	49	do.	0.34	3.43	0.92	9.23	10.05
1940											
Sprayed (2 pounds to 100 gallons):											
Aug. 25-Sept. 2	306	B	GY	Ricey	34	Tart.	0.48	3.27	1.40	8.18	5.84
Sept. 25-30	387	D	PY	Coarse	47	do.	0.45	3.20	1.28	8.57	6.70
Oct. 23-28	399	E	TY	do.	49	P tart	0.46	3.25	1.21	8.77	7.25
Nov. 20-25	499	F	TY	Good	49	do.	0.44	3.27	1.16	8.85	7.63
Dec. 18-23	509	F	TY	do.	49	do.	0.44	3.27	1.08	9.16	8.48
1941											
Jan. 15-20	514	F	TY	do.	49	do.	0.42	3.40	0.99	8.99	9.80
Feb. 12-17	561	G	TY	do.	49	P tart to S	0.38	3.38	0.93	8.83	9.49
Mar. 11-16	527	H	TY	do.	51	do.	0.39	3.41	0.92	8.90	9.67
Apr. 8-13	572	H	TY	do.	51	P tart to S, W	0.38	3.51	0.76	8.68	11.42
May 6-11	551	H	TY	do.	51	do.	0.37	3.64	0.71	8.62	12.14

³ V, very; P, pleasantly; S, sweet; W, watery.⁴ Each figure represents a mean of duplicate determinations.¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 43.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on rough lemon rootstock at Davenport, Fla., 1941-42

[Sprayed with lead arsenate at the rate of 2 pounds to 100 gallons of water in July 1941; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Flavor (arbitrary standard) ³	Ascorbic acid per mil- liliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
1941											
Unsprayed:	Gm.	B	GY	Riley	Ml.	V acid.	Mg.	pH	Percent	Percent	
Aug. 25-Sept. 2	285	C	PY	do	33	Actd.	0.47	3.12	1.69	8.56	5.07
Sept. 25-30	389	D	PY	do	43	do	.44	3.11	1.46	8.41	5.76
Oct. 23-28	454	E	TY	Coarse	45	do	.41	3.11	1.30	8.68	6.68
Nov. 20-25	524	E	TY	do	45	Tart.	.36	3.04	1.25	9.00	7.20
Dec. 18-23	614	E	TY	do	44	do	.35	3.01	1.22	8.76	7.18
1942											
Jan. 15-20	626	E	TY	Good	44	P tart.	.30	3.04	1.18	8.69	7.36
Feb. 12-17	592	F	TY	do	51	do	.30	3.16	1.16	8.60	7.41
Mar. 11-16	685	F	TY	do	46	do	.30	3.14	1.07	8.47	7.92
Apr. 8-13	719	F	TY	do	45	do	.30	3.21	1.07	8.59	8.03
May 6-11	787	F	TY	do	47	do	.29	3.38	.89	8.34	9.37
1941											
Sprayed:											
Aug. 25-Sept. 2	290	B	GY	Riley	33	V acid	.49	3.33	1.34	8.68	6.48
Sept. 25-30	336	C	PY	do	48	Tart.	.45	3.31	1.02	8.91	8.74
Oct. 23-28	480	D	PY	do	44	P tart.	.41	3.40	.90	8.98	9.98
Nov. 20-25	514	E	PY	Coarse	43	P tart. W	.39	3.40	.90	9.08	10.09
Dec. 18-23	573	F	PY	do	44	P tart to S, W	.37	3.41	.80	9.05	11.31
1942											
Jan. 15-20	612	F	TY	Good	43	do	.34	3.46	.77	8.99	11.68
Feb. 12-17	620	F	TY	do	45	do	.34	3.50	.75	8.77	11.69
Mar. 11-16	638	F	TY	do	45	do	.34	3.48	.66	8.65	13.11
Apr. 8-13	695	F	TY	do	44	do	.31	3.79	.54	8.22	15.22
May 6-11	719	F	TY	do	40	do	.29	4.04	.42	7.88	18.76

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet; W, watery.⁴ Each figure represents a mean of duplicate determinations.

TABLE 44.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock at Fort Pierce, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
1942													
Unsprayed:	Gm.				Ml.	Percent			Mg.	pH	Percent	Percent	
Aug. 25-Sept. 2	233	A	GY	Ricey	30	31	V acid	20	0.67	3.01	2.26	11.69	5.17
Sept. 25-30	338	C	PY	do	30	31	do	38	.53	3.04	1.64	11.37	6.91
Oct. 23-28	372	D	PY	Coarse	42	43	Acid	58	.49	3.00	1.64	11.47	6.99
Nov. 20-25	440	F	TY	Good	43	45	P tart.	70	.45	2.98	1.66	11.93	7.19
Dec. 18-23	499	G	TY	do	46	48	Tart.	69	.43	3.02	1.53	12.29	8.03
1943													
Jan. 15-20	562	G	TY	do	47	49	P tart.	78	.43	3.00	1.50	12.13	8.09
Feb. 12-17	627	G	TY	do	49	51	P tart to S	87	.43	3.08	1.41	12.38	8.78
Mar. 11-16	667	H	TY	do	51	53	do	91	.43	3.10	1.30	12.35	9.50
1943													
Sprayed:													
Aug. 25-Sept. 2	213	A	GY	Ricey	28	29	V acid	20	.62	3.06	2.17	12.04	5.55
Sept. 25-30	282	C	PY	Coarse	35	36	do	35	.51	3.09	1.68	11.27	6.71
Oct. 23-28	318	D	PY	do	43	44	Acid	58	.45	3.05	1.72	11.97	6.96
Nov. 20-25	427	F	TY	Good	44	46	P tart.	71	.45	3.14	1.67	12.53	7.50
Dec. 18-23	461	H	TY	do	46	48	do	70	.43	3.17	1.52	12.44	8.18
1943													
Jan. 15-20	504	G	TY	do	48	50	P tart to S	82	.40	3.13	1.31	11.90	9.08
Feb. 12-17	552	G	TY	do	50	52	do	90	.40	3.18	1.39	12.58	9.05
Mar. 11-16	559	H	TY	do	50	52	do	92	.42	3.19	1.25	12.50	10.00

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

TABLE 45.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock at Vero Beach, Fla., grove 1, 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
Unsprayed: 1942	Aug. 25-Sept. 2												
	Sept. 25-30	Gm.	B	GY	Ricey	Ml.	Percent	V acid	Mg.	pH	Percent	Percent	4.53
	Oct. 23-28	210	B	PY	Coarse	34	35	do	.54	2.93	2.00	9.05	5.82
	Nov. 20-25	275	D	PY	do	40	41	do	.32	2.96	1.64	9.55	6.03
	Dec. 18-23	335	E	TY	Good	46	47	Acid	.44	3.03	1.61	9.71	7.17
1943	Jan. 15-20	397	F	TY	do	50	52	Tart	.38	2.93	1.44	10.33	7.66
	Feb. 12-17	473			47	49	do						
	Mar. 11-16	466	F	TY	do	54	55	P tart					
	Apr. 8-13	506	G	TY	do	57	59	P tart to S	.38	2.95	1.29	10.14	7.86
	May 6-11	531	G	TY	do	54	55	do	.38	3.05	1.29	10.68	8.28
1942	Aug. 25-Sept. 2	565	G	TY	do	53	55	do	.37	3.07	1.22	10.44	8.56
	Sept. 25-30	585	G	TY	do	56	58	do	.33	3.12	1.06	10.05	9.48
	Oct. 23-28												
	Nov. 20-25												
	Dec. 18-23												
1943	Jan. 15-20	185	B	GY	Ricey	32	33	V acid	.59	3.12	1.55	10.21	6.59
	Feb. 12-17	241	B	PY	Coarse	41	42	Acid	.49	3.09	1.26	10.09	8.01
	Mar. 11-16	305	D	TY	do	46	48	Tart	.45	3.15	1.21	10.41	8.60
	Apr. 8-13	349	E	TY	do	51	53	P tart	.44	3.13	1.02	10.68	10.47
	May 6-11	398	F	TY	do	52	53	Tart	.41	3.26	.93	10.67	11.47
1943	Jan. 15-20	456	F	TY	do	51	53	P tart	.39	3.31	.91	10.54	11.58
	Feb. 12-17	479	G	TY	do	52	53	P tart to S	.39	3.32	.77	10.13	13.16
	Mar. 11-16	451	G	TY	do	53	55	do	.40	3.39	.80	10.74	13.43
	Apr. 8-13	447	G	TY	do	54	56	do	.38	3.56	.65	10.05	15.46
	May 6-11	542	G	TY	do	55	56	do	.34	3.71	.57	10.00	17.54

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.

TABLE 46.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock at Vero Beach, Fla., grove 2, 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
							Arbitrary standard	Numerical rating					
1942 Unsprayed: Aug. 25-Sept. 2 Sept. 25-30 Oct. 23-28 Nov. 20-25 Dec. 18-23	Gm.				Ml.	Percent			Mg.	pH	Percent	Percent	
	203	B	GY	Riccy.	31	32	V acid.	20	0.57	3.08	1.89	10.73	5.68
	244	D	PY	Coarse	39	40	do.	35	.47	3.04	1.68	10.63	6.33
	302	P	PY	do.	46	48	Acid.	57	.45	3.04	1.73	11.23	6.43
	329	F	TY	Good	48	49	Tart.	64	.45	2.98	1.62	11.35	6.90
	410	H	TY	do.	47	49	do.	69	.42	3.02	1.50	11.87	7.91
1943 Jan. 15-20 Feb. 12-17 Mar. 11-16 Apr. 8-13 May 6-11													
	439	G	TY	do.	50	52	P tart.	75	.41	3.02	1.48	11.19	7.55
	464	G	TY	do.	51	53	P tart to S.	81	.40	3.07	1.44	11.38	7.90
	518	G	TY	do.	51	52	do.	89	.40	3.35	1.32	11.27	8.54
	483	G	TY	do.			do.	89	.37	3.40	1.14	11.47	10.06
	549	G	TY	do.	50	54	do.	92	.36	3.20	1.14	11.05	9.69
1942 Sprayed: Aug. 25-Sept. 2 Sept. 25-30 Oct. 23-28 Nov. 20-25 Dec. 18-23													
	202	B	GY	Riccy.	27	28	V acid.	20	.63	3.09	1.78	10.73	6.03
	245	D	PY	Coarse	39	40	do.	35	.46	3.10	1.56	10.88	6.97
	310	E	PY	do.	46	48	Acid.	59	.45	3.02	1.53	11.47	7.50
	331	F	PY	do.	48	50	P tart.	71	.45	3.16	1.38	11.83	8.57
	423	F	TY	Good	47	50	do.	74	.42	3.22	1.22	11.87	9.73
1943 Jan. 15-20 Feb. 12-17 Mar. 11-16 Apr. 8-13 May 6-11													
	418	F	TY	do.	50	52	P tart to S.	81	.42	3.17	1.21	11.79	9.74
	453	G	TY	do.	51	53	do.	89	.41	3.27	1.10	11.93	10.85
	508	G	TY	do.	53	55	do.	91	.42	3.30	1.05	11.87	11.30
	495	G	TY	do.	53	55	do.	90	.38	3.39	.96	11.62	12.10
	511	G	TY	do.	53	55	do.	85	.37	3.47	.84	11.30	13.45

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 47.—Seasonal changes in physical characters and chemical constituents of Marsh grapefruit on sour orange rootstock at Bradenton, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
Unsprayed: 1942	Aug. 25-Sept. 2	B	GY	Ricey	Ml. 29	Percent 30	V acid	20	Mg 0.69	pH 3.05	Percent 2.04	Percent 10.21	5.00
	Sept. 25-30	B	PY	do	37	38	do	24	.53	2.95	1.55	9.57	6.37
	Oct. 23-28	E	PY	Coarse	40	42	Acid	44	.51	2.92	1.74	11.13	6.40
	Nov. 20-25	E	TY	Good	44	46	do	53	.47	2.95	1.67	11.17	6.69
	Dec. 18-23	F	TY	do	48	49	Tart	68	.46	2.93	1.47	11.09	7.54
1943	Jan. 15-20	F	TY	do	49	51	P tart	77	.46	3.00	1.47	11.13	7.57
	Feb. 12-17	F	TY	do	48	50	P tart to S	80	.47	3.05	1.42	11.30	7.96
	Mar. 11-16	G	TY	do	48	49	do	85	.46	3.07	1.41	11.40	8.09
	Apr. 8-13	G	TY	do	49	51	do	84	.45	3.08	1.36	11.56	8.50
	May 6-11	G	TY	do	51	53	do	92	.41	3.22	1.24	11.35	9.15
sprayed 1942	Aug. 25-Sept. 2	B	GY	Ricey	28	29	V acid	20	.65	3.05	1.95	10.26	5.26
	Sept. 25-30	B	PY	do	30	30	do	23	.51	3.05	1.55	9.32	6.01
	Oct. 23-28	E	PY	Coarse	39	41	Acid	47	.51	2.93	1.67	10.53	6.31
	Nov. 20-25	E	TY	Good	43	45	do	52	.49	3.00	1.48	10.13	6.84
	Dec. 18-23	F	TY	do	45	47	Tart	62	.48	2.96	1.54	10.59	6.88
1943	Jan. 15-20	F	TY	do	49	50	P tart	77	.48	3.07	1.34	10.13	7.56
	Feb. 12-17	F	TY	do	49	50	P tart to S	80	.48	3.07	1.38	10.80	7.83
	Mar. 11-16	G	TY	do	50	52	do	87	.46	3.15	1.28	10.70	8.36
	Apr. 8-13	G	TY	do	52	54	do	87	.41	3.12	1.24	10.63	8.57
	May 6-11	G	TY	do	54	56	do	88	.41	3.26	1.11	10.82	9.75

¹ See U. S. Department of Agriculture color chart (pl. 4).

² QY, greenish yellow; PY, pale yellow; TY, tannish yellow.

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

TABLE 48.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on rough lemon rootstock at Lake Hamilton, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
1942					Ml.	Percent	V acid	20	Mg.	pH	Percent		
Unsprayed:	Gm.												
Aug. 25-Sept. 2	306	B	GY	Ricey	28	29	do	36	0.52	3.07	1.86	9.98	5.37
Sept. 25-30	391	C	GY	do	31	35	do	53	.46	2.99	1.75	9.73	5.56
Oct. 23-28	423	D	PY	do	43	44	Acid	62	.46	3.05	1.85	10.63	5.75
Nov. 20-25	451	F	TY	Coarse	40	42	Tart	66	.47	3.04	1.99	11.18	5.62
Dec. 18-23	550	F	TY	Good	41	43	do	66	.43	3.08	1.78	11.08	6.22
1943													
Jan. 15-20	579	G	TY	do	43	45	P tart	71	.43	3.05	1.79	10.84	6.06
Feb. 12-17	615	G	TY	do	43	45	do	76	.44	3.05	1.70	10.92	6.42
Mar. 11-16	671	G	TY	do	43	44	P tart to S	80	.43	3.12	1.54	10.10	6.56
Apr. 8-13	710	G	TY	do	47	48	do	82	.39	3.12	1.39	9.77	7.03
May 6-11	711	G	TY	do	49	50	do	82	.39	3.19	1.33	9.59	7.21
1942													
Sprayed:													
Aug. 25-Sept. 2	408	A	GY	Ricey	25	27	V acid	20	.49	3.15	1.77	9.37	5.29
Sept. 25-30	394	C	GY	do	34	35	Acid	44	.49	3.11	1.53	9.63	6.29
Oct. 23-28	411	D	PY	do	41	42	Tart	63	.50	3.15	1.56	10.68	6.85
Nov. 20-25	454	E	TY	Coarse	41	42	do	69	.48	3.20	1.55	11.03	7.12
Dec. 18-23	518	F	TY	Good	41	42	do	69	.45	3.18	1.50	10.93	7.29
1943													
Jan. 15-20	545	G	TY	do	43	45	P tart	72	.45	3.18	1.41	10.59	7.51
Feb. 12-17	575	H	TY	do	43	45	P tart to S	81	.45	3.24	1.33	10.87	8.17
Mar. 11-16	636	G	TY	do	43	44	do	85	.44	3.36	1.18	10.10	8.56
Apr. 8-13	676	G	TY	do	46	47	do	84	.40	3.38	1.03	9.82	9.53
May 6-11	683	G	TY	do	47	49	do	88	.38	3.37	.94	9.54	10.15

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 49.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock at Davenport, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
							Arbitrary standard	Numerical rating					
1942													
Unsprayed:	Gm.				Ml.	Percent			Mg.	pH	Percent	Percent	
Aug. 25-Sept. 2	367	A	GY	Ricey	28	29	V acid	20	0.54	3.07	1.73	8.87	5.13
Sept. 25-30	440	C	GY	do.	30	30	do.	31	.51	3.08	1.49	8.73	5.86
Oct. 23-28	492	D	PY	do.	42	43	Acid	55	.49	3.04	1.50	9.62	6.41
Nov. 20-25	559	F	PY	Coarse	43	45	Tart	65	.47	3.10	1.57	10.03	6.39
Dec. 18-23	549	F	TY	Good	44	46	do.	67	.47	3.10	1.53	10.67	6.97
1943													
Jan. 15-20	634	F	TY	do.	45	47	P tart	72	.46	3.11	1.54	10.67	6.93
Feb. 12-17	699	G	TY	do.	43	45	do.	78	.47	3.12	1.50	10.62	7.08
Mar. 11-16	727	G	TY	do.	45	46	do.	78	.47	3.12	1.43	10.75	7.52
Apr. 8-13	830	G	TY	do.	45	46	P tart to S	83	.47	3.16	1.31	10.27	7.84
May 6-11	831	G	TY	do.	47	48	do.	88	.45	3.26	1.20	10.05	8.38
1942													
Sprayed:													
Aug. 25-Sept. 2	267	A	GY	Ricey	40	40	V acid	20	.49	3.19	1.52	9.41	6.19
Sept. 25-30	414	C	GY	do.	43	43	do.	37	.49	3.18	1.31	8.98	6.85
Oct. 23-28	460	E	PY	Coarse	43	45	Tart	67	.49	3.18	1.23	9.52	7.74
Nov. 20-25	485	F	PY	Good	42	45	P tart	75	.50	3.19	1.21	10.22	8.45
Dec. 18-23	516	F	TY	do.	44	45	do.	76	.49	3.23	1.20	10.37	8.64
1943													
Jan. 15-20	594	F	TY	do.	44	46	do.	76	.48	3.35	1.11	10.60	9.55
Feb. 12-17	625	G	TY	do.	46	48	P tart to S	80	.48	3.35	1.10	10.17	9.25
Mar. 11-16	667	G	TY	do.	44	45	do.	83	.48	3.46	.96	10.50	10.94
Apr. 8-13	790	G	TY	do.	44	45	do.	84	.46	3.60	.83	9.75	11.75
May 6-11	721	G	TY	do.	48	50	do.	86	.45	3.78	.73	9.50	13.01

1 See U. S. Department of Agriculture color chart (col. 4)

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 50.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on rough lemon rootstock at Minneola, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Sprayed with lead arsenate at the rate of 1 pound to 100 pounds of water.

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
							Arbitrary standard	Numerical rating					
1942 Unsprayed:	Gm.				Ml.	Percent	V acid	20	Mg.	pH	Percent		
	374	A	GY	Ricey	35	34	do	35	0.41	3.14	1.58	8.11	5.13
	434	B	GY	do	40	41	do	35	.37	3.25	1.25	8.26	6.61
	489	D	PY	do	44	46	Acid	59	.34	3.18	1.34	8.62	6.43
	515	E	PY	do	45	46	Tart.	66	.36	3.24	1.34	9.37	6.99
	561	G	TY	Coarse	44	45	do	66	.37	3.22	1.35	9.77	7.24
1943													
	626	G	TY	Good	44	45	P tart	70	.36	3.28	1.33	9.90	7.44
	680	G	TY	do	46	47	P tart to S	80	.33	3.34	1.25	9.50	7.60
	714	G	TY	do	46	48	do	84	.34	3.37	1.20	9.53	7.94
	690	G	TY	do	46	48	do	84	.33	3.41	1.16	9.52	8.21
	688	F	TY	do	50	52	do	86	.30	3.49	1.08	9.08	8.41
1942 Sprayed:													
	346	A	GY	Ricey	33	33	V acid	20	.41	3.27	1.43	8.26	5.78
	420	C	GY	do	33	34	Acid	40	.39	3.12	1.14	8.23	7.22
	455	D	PY	do	45	46	Tart.	60	.36	3.24	1.24	8.59	6.93
	498	E	PY	do	45	46	do	69	.37	3.30	1.17	9.27	7.92
	539	G	TY	Coarse	45	46	P tart	70	.36	3.31	1.16	9.47	8.16
1943													
	603	G	TY	Good	45	46	do	70	.34	3.40	1.16	9.62	8.29
	642	G	TY	do	46	47	P tart to S	83	.34	3.45	1.07	9.40	8.79
	637	G	TY	do	46	47	do	83	.34	3.50	1.04	9.53	9.16
	679	G	TY	do	46	48	do	83	.33	3.58	.94	9.37	9.97
	674	G	TY	do	49	50	do	87	.32	3.71	.90	9.10	10.11

³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 51.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock at Fort Pierce, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
1942													
Unsprayed:													
Aug. 25-Sept. 2	277	B	GY	Ricey	26	Percent	V acid	20	Mg.	pH	Percent		
Sept. 25-30	296	C	PY	Coarse	32	33	do	29	0.53	3.05	1.79	8.98	5.02
Oct. 23-28	392	D	PY	do	42	44	Acid	51	.45	3.07	1.52	8.63	5.68
Nov. 20-25	475	E	PY	Good	44	46	do	55	.44	3.00	1.73	10.07	5.82
Dec. 18-23	571	F	TY	do	43	45	Tart	62	.42	3.07	1.66	10.39	6.26
									.41	3.04	1.56	10.62	6.81
1943													
Jan. 15-20	614	G	TY	do	44	45	P tart	70	.39	2.98	1.54	10.10	6.56
Feb. 12-17	635	G	TY	do	46	47	P tart to S	80	.41	3.07	1.49	9.98	6.70
Mar. 11-16	661	G	TY	do	46	48	do	80	.41	3.04	1.53	10.35	6.76
Apr. 8-13	766	G	TY	do	47	49	do	85	.40	3.09	1.33	9.70	7.29
May 6-11	776	F	TY	do	48	49	do	86	.40	3.18	1.29	9.95	7.71
1942													
Sprayed:													
Aug. 25-Sept. 2	288	B	GY	Ricey	28	28	V acid	20	.54	3.03	1.81	9.02	4.98
Sept. 25-30	371	C	GY	do	36	37	do	32	.47	3.07	1.53	8.73	5.71
Oct. 23-28	420	D	PY	Coarse	43	45	Acid	48	.44	3.07	1.58	9.47	5.99
Nov. 20-25	483	F	PY	do	44	45	Tart	60	.44	3.09	1.46	9.84	6.74
Dec. 18-23	595	F	TY	Good	45	46	do	64	.40	3.08	1.36	9.67	7.11
1943													
Jan. 15-20	625	G	TY	do	45	47	P tart	71	.40	3.08	1.39	9.93	7.14
Feb. 12-17	691	G	TY	do	48	49	P tart to S	81	.41	3.13	1.30	9.85	7.58
Mar. 11-16	673	G	TY	do	49	50	do	84	.40	3.15	1.24	9.85	7.94
Apr. 8-13	737	G	TY	do	49	50	do	86	.39	3.15	1.23	9.50	7.72
May 6-11	800	F	TY	do	47	48	do	89	.34	3.27	1.13	9.60	8.50

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.

TABLE 52.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on rough lemon rootstock at Clearwater, Fla., grove 1, 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
							Arbitrary standard	Numerical rating					
1942 Unsprayed:	Gm.				Ml.	Percent	V acid	20	Mg.	pH	Percent	Percent	
	Aug. 25-Sept. 2	A	GY	Ricey	31	33	Acid	40	0.54	2.99	2.12	9.54	4.50
	Sept. 25-30	D	GY	Coarse	34	35	do	55	.47	2.97	1.73	9.67	5.59
	Oct. 23-28	E	PY	do	43	46	do	59	.46	2.96	1.81	10.38	5.73
	Nov. 20-25	E	TY	Good	45	46	do	58	.44	3.02	1.79	10.63	5.94
	Dec. 18-23	F	TY	do	45	46	do	58	.42	3.07	1.70	10.67	6.28
1943							P tart	70	.42	3.02	1.56	10.48	6.72
	Jan. 15-20	F	TY	do	46	47	do	76	.38	3.10	1.42	10.80	7.61
	Feb. 12-17	G	TY	do	46	47	P tart to S	81	.41	3.17	1.47	10.87	7.39
	Mar. 11-16	G	TY	do	45	48	do	84	.41	3.22	1.41	10.67	7.57
	Apr. 8-13	G	TY	do	46	51	do	87	.36	3.11	1.26	10.73	8.52
	May 6-11	G	TY	do	49								
1942 Sprayed:							V acid	20	.54	3.08	1.98	9.64	4.87
	Aug. 25-Sept. 2	B	GY	Ricey	32	33	Acid	40	.52	3.09	1.56	9.77	6.26
	Sept. 25-30	C	PY	Coarse	37	38	Tart	60	.51	3.06	1.67	11.13	6.66
	Oct. 23-28	E	PY	do	42	44	do	64	.48	3.15	1.56	11.33	7.26
	Nov. 20-25	E	TY	Good	45	46	do	66	.48	3.15	1.62	11.32	6.99
	Dec. 18-23	F	TY	do	45	46	do	66					
1943							P tart	76	.47	3.25	1.40	11.13	7.95
	Jan. 15-20	F	TY	do	45	47	P tart to S	81	.47	3.21	1.43	11.58	8.10
	Feb. 12-17	G	TY	do	45	47	do	85	.47	3.29	1.28	11.47	8.96
	Mar. 11-16	G	TY	do	45	47	do	89	.43	3.37	1.21	11.27	9.31
	Apr. 8-13	G	TY	do	46	50	do	85	.42	3.58	1.00	10.86	10.86
	May 6-11	G	TY	do	48								

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.

TABLE 53.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on rough lemon rootstock at Clearwater, Fla., grove 2, 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
Unsprayed: 1942	337	B	GY	Ricey	Ml. 29	Percent 30	V acid	20	Mg. 0.48	pH 3.22	Percent 1.88	Percent 9.04	4.81
	373	C	GY	do	32	34	do	36	.43	2.98	1.61	9.70	6.02
	409	D	PY	Coarse	44	45	Acid	50	.41	2.96	1.65	10.27	6.22
	484	E	TY	do	44	46	Tart	63	.39	3.07	1.57	10.73	6.83
	533	F	TY	Good	45	46	do	66	.38	3.05	1.58	10.67	6.75
1943	577	F	TY	do	48	50	P tart	70	.37	3.05	1.51	10.59	7.01
	549	G	TY	do	48	49	do	78	.37	3.11	1.57	10.83	6.90
	617	G	TY	do	48	49	P tart to S	83	.39	3.11	1.51	11.27	7.46
	596	G	TY	do	47	49	do	86	.38	3.15	1.37	10.67	7.79
	703	G	TY	do	45	47	do	87	.38	3.25	1.24	10.75	8.67
Sprayed: 1942	285	B	GY	Ricey	32	33	V acid	20	.47	3.15	1.68	9.01	5.36
	349	C	GY	Coarse	37	38	do	39	.42	3.25	1.39	9.35	6.73
	427	D	PY	do	43	45	Acid	53	.42	3.07	1.48	9.92	6.70
	462	E	TY	Good	43	44	Tart	63	.41	3.16	1.52	10.73	7.06
	486	F	TY	do	45	46	do	68	.39	3.17	1.41	10.67	7.57
1943	542	F	TY	do	45	46	P tart	75	.38	3.20	1.37	10.59	7.73
	554	G	TY	do	47	48	P tart to S	82	.38	3.19	1.37	10.73	7.83
	562	G	TY	do	46	47	do	83	.39	3.28	1.24	10.87	8.77
	561	G	TY	do	47	49	do	90	.38	3.23	1.27	11.17	8.80
	557	G	TY	do	47	49	do	90	.39	3.44	1.14	11.83	10.38

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.

TABLE 54.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock at Palmetto, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
							Arbitrary standard	Numerical rating					
1942													
Unsprayed:	Gm.				Ml.	Percent			Mg.	pH	Percent	Percent	
Aug. 25-Sept. 2	319	B	GY	Ricey	35	36	V acid	20	0.48	3.11	1.73	8.34	4.82
Sept. 25-30	436	C	GY	do.	38	39	Acid	40	.45	3.15	1.47	8.77	5.97
Oct. 23-28	448	D	PY	Coarse	44	46	do.	55	.45	3.11	1.47	9.97	6.78
Nov. 20-25	473	E	TY	do.	46	49	Tart.	61	.43	3.17	1.38	10.63	7.70
Dec. 18-23	525	F	TY	Good	48	49	do.	67	.43	3.17	1.39	10.67	7.68
1943													
Jan. 15-20	643	F	TY	do.	50	51	P tart.	77	.41	3.19	1.37	9.87	7.20
Feb. 12-17	641	G	TY	do.	49	50	P tart to S	80	.41	3.25	1.35	10.30	7.63
Mar. 11-16	684	G	TY	do.	49	51	do.	83	.39	3.21	1.40	10.63	7.59
Apr. 8-13	729	G	TY	do.	48	50	do.	87	.41	3.29	1.25	10.62	8.50
May 6-11	671	G	TY	do.	51	52	do.	86	.39	3.34	1.22	10.68	8.75
1942													
Sprayed:													
Aug. 25-Sept. 2	314	B	GY	Ricey	32	32	V acid	20	.51	3.29	1.52	9.02	5.93
Sept. 25-30	403	C	GY	do.	36	36	do.	38	.45	3.27	1.27	9.37	7.38
Oct. 23-28	459	D	PY	Coarse	43	43	Tart.	63	.43	3.21	1.28	9.97	7.79
Nov. 20-25	511	E	TY	do.	47	49	do.	69	.43	3.15	1.22	10.58	8.67
Dec. 18-23	550	F	TY	Good	47	48	P tart.	72	.42	3.29	1.22	10.67	8.75
1943													
Jan. 15-20	676	F	TY	do.	47	49	P tart to S	83	.42	3.34	1.08	10.19	9.44
Feb. 12-17	653	G	TY	do.	50	51	do.	84	.42	3.43	1.08	10.65	9.86
Mar. 11-16	687	G	TY	do.	48	50	do.	86	.42	3.46	.99	10.53	10.64
Apr. 8-13	719	G	TY	do.	48	50	do.	90	.41	3.48	.94	10.67	11.35
May 6-11	727	G	TY	do.	49	51	do.	86	.38	3.54	.93	10.78	11.59

³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 55.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on rough lemon rootstock at Davenport, Fla., 1941-42

[Sprayed with lead arsenate at the rate of 2 pounds to 100 gallons of water, July 1941; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Flavor (arbitrary standard) ³	Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
1941											
Unsprayed:	Gm.	C	GY	Ricey	Ml.	V acid	Mg.	pH	Percent	Percent	
Aug. 25-Sept. 2	317	D	GY	do	32	Acid	0.45	3.25	1.66	8.76	5.28
Sept. 25-30	374	D	GY	do	39	Tart	.48	3.14	1.51	8.75	5.79
Oct. 23-28	479	E	PY	Coarse	40	do	.48	3.15	1.37	9.35	6.82
Nov. 20-25	567	F	PY	do	42	P tart	.40	3.12	1.34	9.45	7.05
Dec. 18-23	639	F	PY	do	46	do	.40	3.15	1.25	9.21	7.37
1942											
Jan. 15-20	701	G	TY	Good	43	do	.39	3.18	1.22	9.88	8.10
Feb. 12-17	717	G	TY	do	43	do	.38	3.20	1.20	10.05	8.38
Mar. 11-16	733	G	TY	do	44	do	.37	3.29	1.14	10.37	9.10
Apr. 8-13	758	G	TY	do	45	do	.37	3.33	1.06	9.63	9.08
May 6-11	796	G	TY	do	44	do	.37	3.49	.95	9.62	10.13
1941											
Sprayed:											
Aug. 25-Sept. 2	322	C	GY	Ricey	31	V acid	.49	3.33	1.42	8.86	6.24
Sept. 25-30	415	C	PY	do	39	Acid	.45	3.32	1.25	8.78	7.02
Oct. 23-28	513	D	PY	do	39	P tart	.46	3.38	1.62	9.05	8.87
Nov. 20-25	586	E	PY	do	42	P tart to W	.42	3.48	.96	9.29	9.68
Dec. 18-23	694	E	PY	Coarse	42	do	.39	3.41	.94	9.51	10.12
1942											
Jan. 15-20	688	F	TY	Good	42	P tart to S, W	.41	3.51	.89	10.08	11.33
Feb. 12-17	739	F	TY	do	42	do	.39	3.60	.84	9.91	11.80
Mar. 11-16	734	F	TY	do	43	do	.39	3.68	.79	9.99	12.65
Apr. 8-13	800	F	TY	do	44	do	.37	3.71	.67	9.75	14.55
May 6-11	815	F	TY	do	44	do	.37	4.41	.53	9.23	17.42

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet; W, watery.⁴ Each figure represents a mean of duplicate determinations.

TABLE 56.—Seasonal changes in the physical characters and chemical constituents of Duncan grapefruit on sour orange rootstock at Dundee, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio
							Arbitrary standard	Numerical rating					
1942 Unsprayed:	Gm.				Ml.	Percent	V acid	20	Mg.	pH	Percent		
	247	C	GY	Ricey	25	26	do	33	.61	3.10	12.61	5.39	
	346	C	GY	Coarse	29	30	do	48	.48	3.02	11.77	5.50	
	386	D	PY	do	43	45	Acid	59	.48	3.07	12.23	5.14	
	388	F	TY	Good	41	43	do	61	.49	3.06	14.18	5.37	
	442	H	TY	do	40	42	Tart		.49	3.05	14.58	5.34	
	1943												
488		F	TY	do	39	40	do	69	.49	3.05	14.07	5.99	
517		H	TY	do	42	44	P tart	78	.45	3.14	14.36	6.03	
553		H	TY	do	44	46	P tart to S	83	.44	3.15	14.04	6.47	
538		H	TY	do	44	46	do	83	.42	3.16	14.27	6.61	
560		H	TY	do	44	46	do	83	.41	3.22	14.44	7.18	
1942 Sprayed:													
	285	A	GY	Ricey	33	34	V acid	20	.55	3.01	12.21	5.07	
	364	C	PY	do	35	36	do	38	.49	3.04	11.79	6.41	
	391	C	PY	Coarse	43	45	Acid	57	.48	3.10	12.43	6.25	
	427	F	TY	Good	41	43	Tart	65	.48	3.10	13.52	6.04	
	479	H	TY	do	41	43	do	68	.47	3.11	14.31	6.91	
	1943												
507		H	TY	do	42	45	P tart	77	.47	3.06	14.39	7.09	
541		H	TY	do	44	46	P tart to S	83	.47	3.20	14.36	7.93	
606		H	TY	do	43	45	do	88	.47	3.19	15.04	8.26	
550		H	TY	do	48	48	do	90	.46	3.20	14.62	8.45	
615		H	TY	do	46	48	do	90	.39	3.23	13.04	7.58	
May 6-11													

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

TABLE 57.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on sour orange rootstock at Fort Pierce, Fla., 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
1942													
Unsprayed:													
Aug. 25-Sept. 2	Gm. 225	C	GY	Ricey	Ml. 28	Percent 28	V acid	20	Mg. 0.58	pH 3.08	Percent 2.13	Percent 11.01	5.17
Sept. 25-30	316	C	GY	do	34	35	do	35	.45	3.04	1.82	10.57	5.81
Oct. 23-28	335	D	PY	Coarse	40	42	Acid	55	.44	3.06	1.92	11.27	5.87
Nov. 20-25	424	F	TY	do	44	45	Tart	61	.44	3.05	1.94	12.08	6.23
Dec. 18-23	463	H	TY	Good	43	45	do	63	.42	3.10	1.98	12.44	6.28
1943													
Jan. 15-20	525	G	TY	do	44	46	P tart	73	.42	3.08	1.79	11.89	6.64
Feb. 12-17	542	G	TY	do	46	48	P tart to S	81	.42	3.12	1.72	12.58	7.31
Mar. 11-16	567	G	TY	do	44	46	do	87	.42	3.18	1.64	12.69	7.74
1942													
Sprayed:													
Aug. 25-Sept. 2	264	A	GY	Ricey	30	31	V acid	20	.54	3.08	2.11	11.01	5.22
Sept. 25-30	351	B	GY	do	34	35	do	35	.42	3.11	1.70	10.38	6.11
Oct. 23-28	372	D	PY	Coarse	44	45	Acid	55	.40	3.17	1.70	10.95	6.44
Nov. 20-25	464	F	TY	Good	46	47	Tart	66	.41	3.11	1.68	11.78	7.01
Dec. 18-23	528	H	TY	do	46	47	P tart	71	.40	3.15	1.54	11.79	7.66
1943													
Jan. 15-20	579	G	TY	do	44	45	do	79	.40	3.15	1.55	11.47	7.40
Feb. 12-17	570	G	TY	do	47	49	P tart to S	83	.40	3.16	1.55	11.97	7.72
Mar. 11-16	592	G	TY	do	47	49	do	86	.41	3.22	1.48	12.24	8.27

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.

TABLE 58.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on sour orange rootstock at Vero Beach, Fla., grove 1, 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acid per acidity ⁴	Total acid ⁴	Total solids ⁴	Solids- ratio
							Arbitrary standard	Numeri- cal rating					
1942 Unsprayed: ⁵ Aug. 25-Sept. 2 Sept. 25-30 Oct. 23-28 Nov. 20-25 Dec. 18-23	Gm. 271 341 404 462 561	B C C E G	GY PY PY TY TY	Ricey- Coarse do Good do	Ml. 30 33 39 47 47	Percent 31 34 34 48 51	V acid do Acid Tart do	20 35 55 65 65	Mg. 0.47 .44 .41 .39 .39	pH 3.04 3.04 3.05 2.98 3.06	Percent 9.67 9.84 10.26 10.59 11.10		4.98 5.59 5.73 6.38 6.89
1943 Jan. 15-20 Feb. 12-17 Mar. 11-16 Apr. 8-13 May 6-11	576 618 630 637 700	G G G G G	TY TY TY TY TY	do do do do do	48 46 49 54 50	49 48 50 56 52	P tart do do do do	75 80 86 89 89	.39 .39 .40 .39 .37	3.06 3.08 3.10 3.13 3.32	1.57 1.59 1.49 1.38 1.28	11.19 11.88 11.49 11.45 11.30	7.13 7.47 7.71 8.30 8.83
1942 Sprayed: Aug. 25-Sept. 2 Sept. 25-30 Oct. 23-28 Nov. 20-25 Dec. 18-23	193 289 356 382 453	B B D E F	GY PY PY TY TY	Ricey- Coarse do Good do	30 37 42 50 49	31 38 44 52 51	V acid do Tart P tart do	20 38 60 74 77	.45 .44 .42 .42 .41	3.12 3.15 3.21 3.28 3.27	1.79 1.53 1.52 1.37 1.30	10.00 10.27 10.41 11.04 11.32	5.59 6.71 6.85 8.06 8.71
1943 Jan. 15-20 Feb. 12-17 Mar. 11-16 Apr. 8-13 May 6-11	491 548 562 571 589	F G G G G	TY TY TY TY TY	do do do do do	49 46 49 51 51	50 48 50 53 53	P tart to S do do do do	81 88 90 91 86	.40 .40 .40 .41 .38	3.36 3.36 3.39 3.50 3.66	1.25 1.13 1.09 .98 .77	11.49 11.78 11.84 11.80 10.95	9.19 10.42 10.86 12.04 14.22

⁴ Each figure represents a mean of duplicate determinations.

⁵ The same data incorporated in table 31. (See footnote 6, table 31.)

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

³ V, very; P, pleasantly; S, sweet.

TABLE 59.—Seasonal changes in physical characters and chemical constituents of Duncan grapefruit on sour orange rootstock at Vero Beach, Fla., grove 2, 1942-43

[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acid ⁴	Total acid ⁴	Total solids ⁴	Solids- acid ratio
							Arbitrary standard	Numeri- cal rating					
1942													
Unsprayed:	Gm.				Ml.	Percent	V acid	20	Mg.	pH	Percent	Percent	
Aug. 25-Sept. 2	240	C	GY	Ricey	23	26	do	32	0.55	3.07	2.05	10.18	4.97
Sept. 25-30	290	C	GY	Coarse	35	36	do	32	.49	3.15	1.88	10.53	5.60
Oct. 23-28	310	D	PY	do	44	45	do	56	.48	3.10	2.02	10.91	5.40
Nov. 20-25	373	F	PY	Good	43	47	Tart	60	.48	2.97	1.91	11.76	6.16
Dec. 18-23	460	F	TY	do	44	46	do	66	.47	3.11	1.74	12.07	6.94
1943													
Jan. 15-20	500	F	TY	do	44	46	P tart	73	.46	3.10	1.81	11.88	6.56
Feb. 12-17	541	G	TY	do	46	48	P tart to S	84	.46	3.15	1.67	12.01	7.19
Mar. 11-16	548	G	TY	do	45	47	do	85	.46	3.19	1.66	12.62	7.60
Apr. 8-13	598	G	TY	do	48	50	do	87	.45	3.19	1.61	12.57	7.81
May 6-11	573	G	TY	do	48	50	do	90	.43	3.28	1.49	12.30	8.26
1942													
Sprayed:							V acid	20	.56	3.15	1.83	10.63	5.81
Aug. 25-Sept. 2	241	B	GY	Ricey	26	26	do	37	.50	3.14	1.70	10.63	6.25
Sept. 25-30	268	D	GY	Coarse	35	36	do	45	.48	3.29	1.80	11.71	6.51
Oct. 23-28	338	E	PY	do	43	45	do	65	.47	3.11	1.72	11.96	6.95
Nov. 20-25	385	F	TY	do	46	51	Tart	69	.47	3.16	1.57	12.51	7.97
Dec. 18-23	460	H	TY	Good	45	47	do						
1943													
Jan. 15-20	487	F	TY	do	48	50	P tart	78	.48	3.17	1.53	12.63	8.25
Feb. 12-17	528	G	TY	do	50	52	P tart to S	85	.46	3.24	1.48	13.13	8.87
Mar. 11-16	547	G	TY	do	48	50	do	90	.46	3.25	1.46	13.17	9.02
Apr. 8-13	590	G	TY	do	50	52	do	90	.43	3.28	1.34	12.62	9.42
May 6-11	579	G	TY	do	51	53	do	94	.43	3.36	1.24	12.65	10.20

¹ See U. S. Department of Agriculture color chart (pl. 4).

² GY, greenish yellow; PY, pale yellow; TY, tannish yellow.

³ V, very; P, pleasantly; S, sweet.

⁴ Each figure represents a mean of duplicate determinations.

TABLE 60.—Seasonal changes in physical characters and chemical constituents of *Duncan grapefruit* on sour orange rootstock at Palmetto, Fla., 1942-43
[Sprayed with lead arsenate at the rate of 1 pound to 100 gallons of water, July 1942; unsprayed trees served as controls]

Treatment and picking period	Weight per fruit	Rind color ¹	Flesh color ²	Flesh texture	Juice per 100 grams of fruit	Juice per fruit	Flavor ³		Ascorbic acid per milliliter ⁴	Active acidity ⁴	Total acid ⁴	Total solids ⁴	Solids-acid ratio	
							Arbitrary standard	Numerical rating						
1942	Unsprayed:				Ml.	Percent			Mg.	pH	Percent			
		Aug. 25-Sept. 2	281	B	GY	Ricey	31	32	V acid	20	0.45	3.22	1.85	9.47
		Sept. 25-30	393	C	GY	do	36	37	do	39	.44	3.08	1.57	9.77
		Oct. 23-28	422	D	PY	Coarse	43	46	Tart	62	.44	2.94	1.73	11.16
		Nov. 20-25	463	E	TY	do	47	49	do	61	.42	2.98	1.71	11.33
		Dec. 18-23	531	F	TY	Good	48	50	P tart	72	.38	3.03	1.58	11.24
1943														
		Jan. 15-20	596	F	TY	do	46	48	do	77	.37	3.12	1.55	11.13
		Feb. 12-17	599	G	TY	do	49	51	P tart to S	84	.37	3.12	1.54	11.33
		Mar. 11-16	647	G	TY	do	49	50	do	88	.36	3.12	1.42	11.23
		Apr. 8-13	643	G	TY	do	50	51	do	89	.34	3.14	1.37	10.83
		May 6-11	684	G	TY	do	50	53	do	91	.31	3.16	1.35	11.23
1942	Sprayed:													
		Aug. 25-Sept. 2	264	B	GY	Ricey	30	31	V acid	20	.50	3.20	1.73	10.07
		Sept. 25-30	369	C	GY	Coarse	38	39	Acid	41	.45	3.16	1.48	10.67
		Oct. 23-28	407	E	PY	do	46	48	do	52	.44	3.26	1.52	11.18
		Nov. 20-25	482	E	TY	Good	47	48	Tart	68	.40	3.17	1.42	11.33
		Dec. 18-23	488	F	TY	do	48	50	P tart	75	.41	3.09	1.48	11.69
1943														
		Jan. 15-20	571	F	TY	do	49	51	P tart to S	83	.40	3.22	1.33	11.21
		Feb. 12-17	598	G	TY	do	50	52	do	87	.39	3.21	1.30	11.40
		Mar. 11-16	607	G	TY	do	50	52	do	90	.38	3.21	1.27	11.33
		Apr. 8-13	623	G	TY	do	51	52	do	92	.34	3.33	1.09	11.11
		May 6-11	638	G	TY	do	51	53	do	93	.36	3.46	1.11	11.68

¹ See U. S. Department of Agriculture color chart (pl. 4).² GY, greenish yellow; P Y, pale yellow; T Y, tannish yellow.³ V, very; P, pleasantly; S, sweet.⁴ Each figure represents a mean of duplicate determinations.



